NASA
Collaboration Survey and Questionnaire Results
for
Leadership Development Program
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The following report details the results of the Collaboration interview survey and questionnaire for the LDP class of 2003-2004. This report contains a brief description of the project itself, followed by a breakdown of results for the survey, the questionnaire, and the executive survey, ending with a summary overview of the project findings.

Project Detail

The mission of the Leadership Development Program (LPD) class is, "undertaking a project with the vision to achieve extraordinary mission success in the 21st century through powerful collaborations. The goals of the project are to: catalog collaboration principles and best practices; infuse collaboration best practices into new and existing tools and programs; and to make recommendations to align organizational incentives and structures to support effective collaboration The LDP class includes 20 high-potential current and future Agency leaders selected from nine Centers. Through this project, the class is working to make an even greater contribution to the Agency during its developmental year."

To that end, Jordan Consulting Services created three assessment instruments; a survey and a questionnaire were created based on the information the class wished to obtain. An executive survey was created for the more specific needs of the Systems Assessment group within LDP. LDP class participants were trained in how to conduct the interview surveys to reduce the possibility of biased survey results. The interview survey asked respondents a series of 18 open-ended questions. The answers were entered into a template and sent to the consultant for inclusion in the main project database. The questionnaire asked respondents to indicate their level of agreement, on a 1 – 7 scale, with 36 statements on a two-page questionnaire for quantitative analysis. The executive survey was qualitatively different than the main survey, as the goals for this survey were slightly different and the time constraints much greater, both in the availability of respondents and the time respondents had available to participate in the survey. There were fewer open-ended questions (7), and far fewer respondents (N=7), due not only to time constraints, but a much smaller pool of possible respondents (i.e., fewer executives).

The LDP group chose to look at a total of 16 collaborations. For each collaboration, an upper management, middle management, and front-line worker from each side of the collaboration were asked to participate in the survey and complete a questionnaire. This resulted in a minimum goal for each collaboration of 6 people to be interviewed and asked to complete a questionnaire. If the collaboration involved more than two organizations, there was a goal of 3 people (one from each working level) from each organization. While most respondents did complete both the survey and the questionnaire, there were some respondents who completed one but not the other. The total number of respondents interviewed for the survey was 90. The total number of respondents who completed the questionnaire was 93. There were 3 survey respondents who did not turn in a questionnaire, and 6 questionnaire respondents who were not interviewed for the survey. A total of 87 respondents filled out both the survey and the questionnaire. There were 7 responses to the executive survey completed in time for this analysis. However a total of 10 executive surveys were conducted and all were used for further analysis by the Systems Assessment group in the LDP class.

Demographic data was collected for each collaboration and for each respondent, for use in analysis of both the questionnaire and the interview survey. The demographics collected for each collaboration were: total project funding, number of people working on the collaboration, start date of collaboration, scheduled end date of collaboration, and actual end date of collaboration (if different from scheduled). Demographics collected for each individual were: working title, job level (assigned by LDP participants into upper management, middle management, and front-line workers based on job title), the enterprise they worked for, the center they worked at, the percent of time they had worked on the collaboration (ex: full time, 50%, etc.), and the length of time they had worked on the collaboration (in months).

How to Interpret Information in This Report

This research includes two primary types of analysis. The first is “trend analysis”, (the first part of the results section). These results identify major trends in the open-ended answers given by respondents. Where trends exist, they are clear enough to be identified as representing a large enough portion of answers given, both distinct enough and with enough in common, to represent either the majority of answers, or sub-themes within the answers. While the process of identifying trends is grounded in a scientifically based research methodology, the appropriate interpretation is not one of scientific certainty, but exactly what the name “trend analysis”

implies – the identification and explanation of trends found in a series of open-ended answers to questions asked.

The second type of analysis included in this report is statistical analysis. There were two types of statistical tests used; correlational analysis and the analysis of variance. The most important thing to keep in mind when reading these results is that this was not an experimental study (which would not be possible for the research questions asked in this case). This is important because unless an experimental research design is used (where the independent variable is manipulated by the researcher) then it is not possible to know if one variable (the independent variable) *causes* changes in another variable.

What we can determine with the statistical tests used in this report are as follows. First, are various items correlated highly enough with each other to be significant? In other words, does the statistical analysis show us that the correlation is strong enough to give us meaningful information about which elements are related to each other. Second, is the difference between groups statistically significant? In other words, is the difference between groups great enough that this difference is meaningful for the purposes of the questions asked?

More practically speaking, we looked at which elements have a high enough correlation with the perceived success of the collaboration. Those elements that are significantly correlated have been shown, through statistical analysis, to be related to the success of the collaboration, in either a positive or negative manner. Therefore it behooves us to view these as elements that either contribute or detract from the success of a collaborative effort *or* that the success of the collaboration either contributes of detracts from these elements. It is not possible to determine whether an element leads to greater or lesser success or whether the success leads to greater or lesser levels of the element correlated – only that they rise and fall in part due to the relationship between them.

The practical interpretation of the analysis of variance, in a non-experimental study, is that (when statistically significant), there are differences between groups that are important and meaningful. Again, we can not safely assume the *cause* of the difference, only that the differences exist, are meaningful, and that plausible theories about the reasons for these differences are needed.

Survey Results

As previously mentioned, the LDP class conducted 90 interviews, with each interview consisting of 23 questions (A copy of the survey is included as Appendix A). The data set was sorted by various demographics in order to detect differences between groups. (For example, we could examine the data sorted by the collaboration the respondent was working on to see if there was a difference in the kinds of answers received by respondents from a particular collaboration.) These results are organized by the questions the respondents were asked. For each question, there is first a summary of what the overall trends were for the answer to that question. This is followed by findings of any differences between groups based on various demographic variables, i.e. by collaboration, by working role, etc. *These are listed only when there is a distinct and common theme for a given group on a given question, as opposed to a wide variety of answers for which there is no clear and distinct way to encapsulate answers for a given group*.

When examining the following possible groupings of data (enterprise, funding level, number of people on the collaboration, years scheduled for the collaboration, percent of time working on the collaboration, length of time working on the collaboration, and whether or not there was a difference between actual and scheduled end dates), it became apparent that these additional analyses of the data offered a picture of collaborative efforts that did not vary enough from the overview of all the data taken together as to add any meaningful information. However, examining the differences between collaborations, centers, and in one case, working role, did yield information about differences between groups that can add meaningful information to the overall picture of collaborative efforts at NASA.

Survey data Trends

<u>What technology was used as a tool for communication in this collaboration? (examples: phone, email, virtual teaming, etc.)</u>

The most commonly listed forms of technology used for communication were, email and phone, whether for direct personal communication or for teleconferences. Videoconferencing (VITS) was used, although not always with great ease or success, as well as Virtual Teaming. Powerpoint for presentations and faxes was also listed. Several different types of common sites or servers for sharing information were used, although the specific ones used depended on the project (more detail about each of these is contained in the breakdown by collaboration). Those

listed were: MSFC common library, share drives for documents, Web-X, FTP servers, SPICE (Space Program Contract Environment), document server systems such as EVS, PIMS, and Project Link, as well as the Management Information System, Collaborative Engineering Center, and SAIC web hosting. Other specialized systems used included NEXPRISE, TEM (Technical Expert Matrix), a high speed data link T-3 line, and an instrument integration phone.

One of the more interesting trends in these answers is that many non-technological items were given as answers to this question, including face-to-face meetings (which would include on-site meetings), the use of professional facilitators, and travel to different Centers for in person meetings. The fact that such distinctly non-technical items were listed in response to this question highlights the importance of interpersonal interactions to the respondents.

The only meaningful trends to be reported are those listed by collaboration.

Collaboration

Collaboration 3. SPICE (Space Program Integrated Contract Environment),

Collaboration 5. NEXPRIS, Web-ex

Collaboration 6. Technical Expert Matrix (TEM)

Collaboration 7. Web-ex, Net Meeting, STIN (Space Transportation Information Network), Windchill PDM, , Phoenix Integration Model Center

Collaboration 9. Web-ex

Collaboration 10. Instrument integration phone

Collaboration 11. Web-ex.

Collaboration 15. Collaborative Engineering Centers

What kinds of technology would have offered a significant improvement on your ability to communicate and affect the success of the collaboration? How would this technology have made the collaboration more likely to succeed?

Although distinctly non-technical, the most common response to this question was face-to-face meetings. This is important, not only because of the strength of this trend, but because it is a distinctly non-technical answer to a question about technology, highlighting again the importance of personal interactions in collaborations. Responses as to why this would make collaborations more likely to succeed were: the importance of getting all parties together to address issues, the importance of forming personal relationships to foster an understanding of the people involved and how best to communicate with them, and that other forms of

communication (such as emails) can be subject to misinterpretation. In short, there is no substitute for personal interaction in the ability to establish the relationships and trust necessary for effective communication.

A videoconferencing system that works well, consistently, and has easy access was seen by many as offering pivotal improvements in communication. If actual face-to-face interaction is not possible, video-conferencing is seen as being very helpful, especially when people don't know each other well. Videoconferencing enables one to see body language, put a voice to a face, and see the sincerity of the person speaking. All of which establishes trust, and helps people become more comfortable with each other. This allows for more comfort in sharing information and more willingness to take part in the collaborative process.

Web-based systems of information sharing are also seen as offering much in the ability to collaborate successfully; provided that they are user-friendly, that data can be accessed at all times, and, as much as possible, work in real time to enable collaboration in real time. This kind of system, according to the respondents, would improve efficiency, make information more accessible, improve communication, and allow people to work technical issues together in real time. Ideally, such a system would make it possible for people to share documents during either a teleconference or a videoconference. A web-based system would also reduce phone and email overload, which makes it difficult for people to respond efficiently to issues of true priority. This ability was also mentioned specifically in relation to budget data, where a lapse in timing creates unnecessary difficulties.

Several people also highlighted the importance that any new technology used must be both user-friendly and accessible by all, otherwise the learning curve involved is more of a hindrance that a help. Ineffective technology was seen as worse than a lack of technology. There were recommendations for specific technologies that are more clearly detailed in the breakdown by collaboration. (More than a few respondents with a healthy sense of humor were highly enamored of the idea that NASA work on transporter technology, a la Star Trek. This idea actually contains yet another reinforcing message about the importance of face-to-face communications. Plus, respondents said that it would be "really cool.")

The only meaningful trends to be reported are those listed by collaboration. Video conferencing was seen as distinctly desirable by every collaborative effort as offering

improvement in the collaborative process. This finding emphasized the importance of some form of personal interaction and should not be ignored.

Collaboration

Collaboration 1. Video phone with document sharing.

Collaboration 5. More face-to-face meetings and co-location.

Collaboration 7. Better and more accessible virtual conferencing tools (videoconferencing and web hosting).

Collaboration 8. Easy to access videoconferencing.

Collaboration 9. High quality videoconferencing.

Collaboration 10. More face-to-face meetings, better videoconferencing and teleconferences.

Collaboration 12. Video conferencing that is easily accessible.

Collaboration 13. More face-to-face meetings and videoconferencing.

Collaboration 14. Videoconferencing with document sharing.

Collaboration 16. Web based document storage, better videoconferencing technology.

What types of *formal agreements* are recognized and recorded as to who is responsible for various aspects of the collaboration? Was this type of agreement effective? Would a less formal agreement have been helpful?

There were many types of formal agreements mentioned by respondents. Some types of agreements were seen as more effective than others. Memorandums of Understanding (MOUs), were seen as the most effective formal agreements mentioned. Second in its perceived level of effectiveness were Project Plans. Most found this a very effective type of agreement, although a very small portion of respondents listing this type of agreement found it to be lacking in flexibility or a bit disappointing. Those listing the Space Act Agreement were almost evenly split, with roughly a third finding it not effective, a third finding it effective, and a third stating mixed results, either because it was not re-validated at a later date, or was not sufficient to ensure buy-in from all parties. Memorandums of Agreement (MOAs) were not seen as effective, either because an agreement was not considered binding at all levels, or did not have endorsement/buy-in at all levels. Program Plans were seen as effective as long as they were allowed to evolve with the program. The main value of ICDs was in defining what was needed or forcing participants to think through what was needed. Task Agreements were seen as highly effective. Partnership

agreements were effective, but Teaming Agreements were seen almost equally as effective and ineffective. Contracts and Work Split Documents were effective once settled, and seen as the best way to avoid problems. Program Operating Plans were not seen as effective by any respondent listing it, largely due to the ability to misinterpret the Plans.

The overwhelming response to whether or not less formal agreements would have been helpful was "no". However, what seemed to be most important was not which type of agreement was utilized, but whether or not that agreement had buy-in by participants in the collaboration, whether or not the agreement clearly defined roles and responsibilities, and if the agreement was in place early enough in the project to be effective. These issues were mentioned spontaneously by a large number of respondents, although the question did not ask what would make agreements more effective.

Other formal agreements mentioned were: the NASA budget system, Study Plans, Consortium Structure, Grants, NCAM, Systems Engineering Management Plans, Configuration Management Plans, Baseline Delta Review, Articles of Collaboration, Requests for Information, and Implementation Plans. There were not enough of these listed to define any trends in the overall data, although there are some specifics about these agreements in the Collaboration breakdown.

Collaboration

Collaboration 1. A number of agreements were listed, which were seen as effective.

Collaboration 2. Space Act Agreement was most often listed, and seen by most, but not all, as effective.

Collaboration 3. MOAs were not seen as effective for this collaboration – they were developed too late and ignored by centers

Collaboration 4. MOAs were seen as effective.

Collaboration 5. Consortium structure, teaming agreements and project plans were listed. The most identifiable trend was that there needed to be more clear definition of roles and responsibilities.

Collaboration 6. Co-operative agreements were seen as effective

Collaboration 7. The lack of identified formal agreements was the only trend here.

Collaboration 8. Study plans were seen as partially effective.

Collaboration 9. The JSRDA (a Space Agreement Act) was not seen as effective, because there were shifts in roles and responsibilities that the document was not flexible enough to cover, which led to inconsistencies and misunderstandings.

Collaboration 10. A number of agreements were listed. The formal agreements with Japan were seen as effective, and ICDs were effective in that they helped for planning. Agreements with a non-NASA entity in support of measurements at the center were not effective in the long run because people failed to live up the agreements.

Collaboration 11. Task agreements were seen as effective, MOUs were not, both for the same reasons: the presence or lack thereof of clearly defined roles and responsibilities.

Collaboration 12. Proposal plans were seen as effective and less formal were not seen as desirable.

Collaboration 13. The Space Act and the contract with a non-NASA entity were listed. The Space Act was seen as effective by some, but not by others. The contract was seen as effective.

Collaboration 14. MOAs and other written agreements were seen as effective.

Collaboration 15. Technical task agreements with centers were seen as effective.

Collaboration 16. Partnership plans and program plans were seen as effective.

Center

Center C. MOUs were the most frequently mentioned agreements and were seen as effective.

Center D. There was a perceived lack of any formal agreements from respondents at this center. Most thought that formal agreements would have been helpful.

Center E. MOUs were the most frequently mentioned agreements and were not seen as effective.

Center H. The Space Act Agreement was the most frequently mentioned and was seen by most, but not all, as effective.

What types of *informal agreements* are recognized and recorded as to who is responsible for various aspects of the collaboration? Was this type of agreement effective? Would a more formal agreement have been helpful?

The kinds of informal agreements mentioned most often were: Action Items, seen as very effective; non-documented agreements or informal agreements, also seen as effective; and regularly scheduled meetings (the agreement to have them), also seen as effective. Various kinds of plans, action plans, test plans, work plans, and working guidelines were seen as effective and appropriate for the project concerned.

Once again, the overwhelming response to whether or not a *more* formal agreement would have been helpful was "no". And once again, what seemed to be most important was not which type of agreement was utilized, but whether or not that agreement had buy-in by participants in the collaboration, whether or not the agreement clearly defined roles and responsibilities, and if the agreement was in place soon enough in the project to be effective. Therefore, the reasonable conclusion to draw from the answer to this and the previous question is that the level of formality needs to be determined by the type of collaboration embarked upon. What is critical to any agreement, formal or informal, is that roles and responsibilities are clearly defined and universally available, and that these are in place at the beginning of the project, with the flexibility to evolve as the project does. The ability to clearly delineate these items and have the necessary buy-in from all collaboration partners requires more up-front work, before the project begins. The cost of not doing this up-front work should not be underestimated. It affects the ability of all members to collaborate and directly affects the potential success of the project. Also, while more time up front is required, it is more than adequately made up for in the execution of the project, because it results in less time wasted and less frustration on the part of all involved, with the bonus of the added enthusiasm and commitment of all parties when there is universal buy-in.

Other types of informal agreements mentioned, but not often enough to define as trends, were: email inquiries, POP budget presentations or budget plans, verbal agreements, billing paper trails, extensive documentation, technical coordinating committees, working group agreements, project team member assignments, ISO control documents, agreements documented by consultants, funding agreements, scheduling, interface agreements, memos, minutes, presentation materials, aero and flight controls, organization charts, IPTs, risk documents, management plans, project manager schedules, technical work-split documents, and statements of work

Collaboration

Collaboration 2. Emails and personal interactions were seen by many as the most effective way to sort through problems.

Collaboration 6. Informal agreements were seen as effective, and as laying the groundwork for more formal arrangements. Strategic monthly meetings were seen as very effective and very important. Both of these, as phrased by respondents, were seen as examples in which the development of personal relationships and understanding led to greater progress in the development of the project.

Collaboration 7. Organizational charts were helpful in defining roles and responsibilities.

Collaboration 10. For this particular project, the formality of agreements was seen as very important. Informal agreements, such as verbal agreements later documented in email, were effective in day-to-day operations.

Collaboration 11. Emails, as recorded evidence of agreements were seen as highly ineffective in this case.

Collaboration 12. Emailing arrangements and verbal agreements were seen by some as effective and by others as not at all effective, depending on whether or not there was clear follow-through on these agreements. When there was not, more formality was wanted.

<u>What organizational processes inhibited collaboration? How did these inhibit collaboration? How would you fix these things?</u>

There were two dominant themes in these answers. The first was process and/or procedure differences between collaborating groups. These were seen as leading to confusion and conflict. Possible solutions listed are: up front work – working together on all operating agreements and getting buy-in from all parties on how it will be done (or don't collaborate); a customer handbook for outside participants that has all the requirements in one place; making sure rules are traceable to NASA guidelines; having continuing communication to clarify issues; having a single point of contact for all parties.

The second, and equally large, trend, was that of budget and funding processes. The reasons for these being inhibiting processes were numerous. Agreed upon budget was not delivered, or not delivered as scheduled; a lack of resource reports, leading to confusion about who was paying for what; different accounting systems across organizations; people delivering product were not in control of the funds for the project; budget cuts without warning; delays in

authority to proceed in some areas, work slow-downs in other areas. Solutions listed were: an integrated funding process; having an advocate for distant Centers; more widespread use of a bank card; collaboration between CFOs; HQ control of budgets; a distributed system that avoids a one size fits all solution (would be cheaper and more effective).

Problems with the system for allocating travel funds were a distinct trend that was encompassed in funding issues. The lack of travel funds, or the difficulty involved in getting travel funds, was seen as limiting the ability to collaborate and the need to meet for testing and integration. Possible solutions were: giving the control of travel funds to the researcher instead of the institution; re-thinking the way travel is funded; and assigning travel dollars to the project to control that are commensurate with the budget and needs of the project.

There were many problems with the clarity of processes in general, as opposed to particular processes. Processes were seen as lacking initial agreement or buy-in, too rigid, not well thought out, with too many competing processes, and lacking in the coordination of processes. The solutions to these problems was repeated numerous times: there needs to be up front work to agree on which processes will be used and there will be used and to get buy-in from all parties. Processes need to have a clear definition of roles and responsibilities built in.

Collaboration

Collaboration 1. Two centers competing for the same pool of money was seen as the largest inhibitor for this project.

Collaboration 2. A complicated communications system, where there were a set of rules for dealing with the contractor, presented difficulties. "NASA is not allowed to talk to city contractors who are doing the work." The different goals and agendas of NASA, the city of Cleveland, and the contractors also presented obstacles.

Collaboration 3. The processes at different centers were not aligned. One center's processes were used, with no buy in from the others, creating resentment and a lack of buy-in on all sides. Those from the center whose processes were used felt they had all responsibility without the means to influence other centers, and other centers resented their own lack of control. The result was difficulty in managing the contract and the project. Communications between centers on this project appears to have been abysmal.

Collaboration 5. The difference in processes and cultural styles between centers and industry created a clear problem for respondents, as did the lack of clear roles and responsibilities. This seems to have lead to the lack of trust for other team members.

Collaboration 7. The lack of a One NASA approach was apparent in many comments. There was insufficient personal interaction, a lack of a team identity that could surpass center identities, differing processes between centers, and different levels of formality at different centers, which needed to be overcome with more face-to-face meetings and possibly team building exercises.

Collaboration 9. There was a lack of appreciation and trust for other ways of doing business in this collaboration, aggravated by one groups' process being forced on another group, which then felt free to ignore it. There needed to be up front work on creating a process that had buy-in from all parties.

Collaboration 10. Budget constraints and stovepiping were seen as this projects biggest inhibitors. There seemed to be a need for better integration for the project from the upper levels involved in this projects.

Collaboration 11. Different processes at different centers and with the contractor led to a lot of frustration and confusion on this project. There was a call for more up-front work on coordinating processes at the beginning of the project, in a way that is traceable to NASA guidelines.

Collaboration 12. Funding, travel, and funding for travel were seen as the largest inhibitors for this project. The lack of face-to-face interaction that resulted led to mistrust. The funding and travel problems led to frustration. Personal interaction was needed for testing and integration.

Collaboration 16. Different processes and different terminology was an inhibitor in this project, as well as the high rate of staff turnover. Joint program management was offered as a solution to the problems created by different processes.

<u>Center</u>

Center D. Center competition and stovepiping was most often mentioned by this group.

Center E. The difference in center processes was also a strong trend for these respondents, with the same results.

Center G. The difference in processes between centers was a strong trend, leading to miscommunication, frustration, and inefficiency.

What organizational processes enhanced collaboration? How did these enhance collaboration?

There was one overwhelmingly consistent identifiable trend in the answers to this question. By far, the ability to develop personal relationships, through face-to-face interactions, regular scheduled meetings, or team building was seen as most important in enhancing collaboration. This is extraordinarily interesting, as the majority of these do not involve official processes, per se, with the exception of scheduled meetings being built in to the process. The reasons for the effectiveness of these various forms of relationship building are numerous. Communication is more open, trust is built, organizational and cultural differences are understood better and more easily overcome, and it is easier to resolve disparate issues when there are personal relationships in place. A direct quote summarizes this point nicely, "when you know each other, it is much easier to pick up the phone to communicate, solve problems, and collaborate." Regularly scheduled meetings were seen as important because they afford the opportunity for an overview of the project as it proceeds and also offer the opportunity to resolve issues, speed up the decision-making process, and enhance information flow.

The second trend, although much smaller, was that of an effective funding or procurement process. Receiving funding in a timely manner quite simply enabled people to do their jobs. This was much easier when the process was clearly structured and everyone was familiar with it. The ability to allocate travel funds when necessary was also mentioned as enhancing the collaborative effort.

Collaboration

Collaboration 4. Regularly scheduled meetings enhanced collaboration.

Collaboration 5. The personal relationships that were built through meetings, and face-to-face interactions, along with managers who made an effort to resolve problems, were the things most mentioned here.

Collaboration 9. The establishment of teaming efforts enhanced collaboration at the personal and technical levels.

Collaboration 10. The ability to communicate and collaborate in person enhanced this collaboration.

Collaboration 12. The proposal process clarified roles and responsibilities, which greatly enhanced collaboration. Several people stated that face-to-face interactions helped establish trust and relationships.

Collaboration 13. The Space Act Agreement was seen as providing the structure for the collaboration to occur.

Collaboration 16. Formal reviews were viewed by many as being extremely helpful in this collaboration, keeping members on the same page and offering direction when needed.

What are the cultural traits of NASA and/or the working groups that inhibited collaboration? How did these inhibit collaboration? How would you fix these things?

Among several clear trends, the most frequently mentioned was cultural and organizational differences. These differences, when not resolved, led to misunderstandings, frustration, delays, mistrust, conflict, lowered morale, and an unwillingness to share information and knowledge, all of which undermined the collaborative effort. The solutions mentioned were: well defined requirements, a willingness and ability to communicate, and treating everyone involved equally and with respect. Practical ways to achieve these aims involve an orientation period, where people get to know each other, details at other center to expand understanding of cultural differences and solutions to them, more inter-center interaction, and up front work at acknowledging differences and learning to blend cultures, rather than having one culture dominate.

Another trend can be classified as a lack of One NASA thinking, which was not only a distinct trend, but could also encompass two other clear trends, which were Center or Enterprise competition, and a lack of respect for different centers (or organizations or contractors). All of these were inhibiting factors. They inhibited the flow of communication, minds were closed to new ideas, and the lack of respect for others severely lowered morale and created friction, wasting time and resources. Communication and up-front work were once again given as the key to resolving these issues. Possible solutions giver were: an agreed upon set of values and a common goal, clearly traceable to the NASA mission and goals, with the time to develop personal relationships.

Fear of failure and risk aversion are also inhibitors to success. In the words of respondents, “it is not ok to fail, so it is not ok to be honest” and “no one could make a decision

because no risk was acceptable." Solutions mentioned are establishing a level of acceptable risk, and less "liability" for failure.

Inflexibility, or "it wasn't invented here" was also seen as inhibiting collaboration. People unwilling to be open to new ideas or ways of doing things created friction and damaged the potential for collaboration, because there was no point of negotiation and therefore no way to move forward. Solutions mentioned were the need for someone at a high enough level to argue a case and be an advocate (overcoming intransigent individuals), and training people when they come together to fully understand and accept the responsibilities of themselves and others.

Collaboration

Collaboration 2. The difference between how NASA functions and how contractors function was listed several times as inhibiting progress and hampering the ability to make decisions.

Collaboration 3. Inter-center rivalry and competition were the biggest factors for this group – parochial approaches that were inflexible and unwilling to compromise or take a One NASA approach.

Collaboration 5. The two themes for this group, which seem inter-related, were the need for more trust, and the "master/slave" attitude by some NASA personnel towards contractors.

Collaboration 6. The difference is processes, especially as related to hiring, was an obstacle for this project. The non-NASA entity personnel did not think that NASA appreciated the length of the process necessary for hiring in their particular setting, and NASA was frustrated with the length of time it took. Both the non-NASA entity and NASA seem to have believed that they alone knew best how to do things, resulting in some initial power struggles.

Collaboration 7. Two particular aspects of center parochialism emerged as themes for this group. The first was stovepiping, and the second was the attitude that "it wasn't invented here", so it's not worth doing.

Collaboration 9. The various Collaboration 9 labs appear to have been run very differently and have had very different motivating forces, which created a good deal of conflict. People also seemed less willing to share information and there were more adversarial personal relationships, all of which impeded progress.

Collaboration 10. Almost all these respondents felt that inter-center rivalries were the biggest obstacle to collaboration, breeding mistrust and an unwillingness to share information. These issues were smoothed over a bit when funding issues were resolved.

Collaboration 11. Cultural differences between centers and enterprises, including the differing levels of formality at various centers, were inhibitors to success.

Collaboration 12. Inter-center rivalries, competition, and refusal to move from within a given center's cultural framework made it very difficult to actually collaborate, as opposed to working separately on the same project.

Collaboration 14. This collaboration mirrored Collaboration 5 in its themes – a lack of trust between groups and a lack of respect for contractors.

Collaboration 15. The biggest obstacles for the Collaboration 15 team have been center rivalries and stovepiping. Stronger centralized leadership from HQ was a solution offered.

Collaboration 16. Center differences and the fear of failure were the both themes for this set of respondents.

Center

Center D. Stovepiping was a strong trend here.

Center E. Center based rivalry and parochialism were the biggest inhibitors to success.

Center F. There were two dominant issues here. The first was the control issue involved between NASA and a non-NASA entity. NASA was seen as needing to be in control and treated with deference. The non-NASA entity and NASA were both seen believing they know best how to proceed. The second was the more formal, structured culture at one center, which did not always mesh well with other centers.

Center J. Turf protection was the item most often listed, followed closely by a lack of communication and trust between Center J and Center B.

What are the cultural traits of NASA and/or the working groups that enhanced collaboration?

NASA as a whole has a number of strengths that lend themselves to collaborative efforts. The first is that of a science community with the goals of good science. Respondents noted that the goal of good science forces everybody towards the collective goals, the policy of working

with the science community promotes collaboration in an effort to further knowledge, and the agency appreciates the need for basic research and how to go about it.

The more dominant trends all concerned the individual attributes of the NASA employee population. NASA employees are highly motivated and strive for excellence and success. They are dedicated, and willing to put in the time to get the job done. That people want to do good work creates the impetus to overcome mistrust to, in order to "get things done, and get them done right." The knowledge and expertise of NASA employees was also a distinct trend, and seen as often speeding along the process due to a reduced learning curve.

In short, the major strengths of the NASA population, according to respondents, is a workforce filled with pretty remarkable people, who are motivated, strive for excellence, and have a wealth of knowledge, all of which is directed towards the goals of good science and the furtherance of knowledge.

Collaboration

Collaboration 1. Mutual respect and a common vision.

Collaboration 2. Most people cited the attitude of the team members, their dedication and knowledge, and that "they wanted to get it done, and get it done right", as overcoming obstacles to success.

Collaboration 3. The individual desire for individuals to be successful at what they are working on was a strong theme for this group.

Collaboration 6. A shared research mentality and mutual respect seemed to be the biggest assets for these respondents.

Collaboration 7. The statement that best encapsulates the theme for this group is "people want to do good work, and want to figure out what the answers are."

Collaboration 9. Dedication and a "can do" attitude were seen as being strong strengths for this group.

Collaboration 11. The drive at NASA to put the time in and get the job done.

Center

Center E. The individual and common desire to be successful was a clear trend.

Center H. The desire to get things done and get them done right was mentioned frequently.

In what ways did the parties involved in this collaboration receive recognition for their work? How could recognition of people and teams be improved?

There were many types of recognition listed. The most common was Group Achievement Awards, followed by Publicity or Public Relations. Verbal recognition from superiors and recognition from peers were next and were mentioned in roughly equal amounts, as were presentations and conference papers, which came next in frequency of times mentioned.

Whether or not recognition was perceived as adequate was dependent, not on the Agency as a whole, but rather on things such as which project was worked on, and which center the respondents work at, which is further detailed below.

There were several recurring suggestions for improving recognition. The most frequent thing mentioned was the importance of peer recognition. This was seen by many people as the most meaningful and important kind of recognition. For recognition to be meaningful, it must also be timely, which seems to have been an issue many times. Along those lines, if a recognition event is scheduled, it is rather pivotal that those being recognized can attend the event, which has not always been considered.

A few very interesting suggestions pointed towards the need for an Agency wide standard for recognition that is meaningful and carried through in a timely manner. Many feel that recognition efforts often miss those who deserve it and award those who don't, because the standards for recognition are so varied from project to project and center to center. For recognition to be meaningful, the standards for recognition must be clear.

Some specific recommendations are: having an honors function at science meetings; recognizing people and collaborations (above and beyond Group Achievement Awards); letting project managers write, or partially write, performance appraisals; a specific award for inter-center team collaboration, which involves additional challenges; articles in center papers, personal visits from superiors to thank individuals; recognition for meeting milestones; awards that improve productivity, such as laptops, etc.; money with awards; and time off.

Collaboration

Collaboration 2. None, most would have appreciated recognition.

Collaboration 3. None, most felt their work wasn't recognized in any meaningful way.

Collaboration 5. There were consortia awards, but no NASA awards, and there were ethical considerations for the consortia to recognize NASA employees.

Collaboration 7. Individual, on-the-spot, and group achievement awards

Collaboration 10. Awards varied greatly due to center.

Collaboration 11. Awards varied greatly due to center.

Collaboration 12. Group Achievement awards.

Collaboration 16. Several people received peer recognition.

Center

Center B. Approximately half of these respondents listed some kind of recognition, usually Group Achievement Awards.

Center C. People at this center all listed some form of recognition, although not all the same kinds of recognition.

Center E. The majority of respondents did not list any form of recognition, and many in fact had negative responses to this question, such as "the few examples of recognition were done only to placate the workforce", "little given, they were expected to defend their centers' turf", and "promotions were implied when assignments were made, but were not implemented."

Center G. Not seen as effective in recognition.

Center H. Not seen as effective in recognition.

Center I. Peer recognition and positive feedback were mentioned.

Center J. Group Achievement Awards and "no recognition" were equally strong trends.

What metrics were used to measure the success or failure of this collaboration?

While there were metrics specific to projects, seen as a whole, the metrics used to measure success most commonly mentioned were: meeting schedule deadlines, the success or failure of the project or performance of product, meeting budget requirements, and project requirements or requirements documents. Mentioned just as often as project requirements was the lack of any metrics, or that the metrics were still being defined.

Collaboration

Collaboration 2. The NASA entity saw budget and schedule as metrics, the NASA side saw no formal metrics as being in place.

Collaboration 3. The only metrics mentioned were those implemented for contractor performance.

Collaboration 4. Cost and schedule.

Collaboration 5. Milestones and spending.

Collaboration 6. There were many formal metrics agreed on, including customer satisfaction survey, approval of contracts, number of technical reports, revenue produced, personnel, third party funding, graduate program growth, and participation in the education program.

Collaboration 7. Analyses completed, schedule and budget.

Collaboration 9. Metrics still being established.

Collaboration 10. Success of the mission, delivery of product on schedule and in budget.

Collaboration 11. Cost and schedule.

Collaboration 12. The metrics most mentioned here were the science accomplishments, schedule, and budget.

Collaboration 13. Test data.

Collaboration 16. Cost and schedule.

Center

Center C. Budget and schedule.

Center G. Schedule milestones.

Center J. Meeting science objectives/mission success requirements

How did Senior Management support this collaboration? What other kinds of support would have been helpful?

The most frequently mentioned types of support were: receiving funding through project completion, and the lack of micromanagement. Closely aligned to funding issues was the appreciation for the provision of staffing and facilities with which to conduct the project. Mentioned almost as frequently were items that could be grouped as the personal approach of Senior Managers; including encouragement and enthusiasm, honest communication, and trust. Quarterly/Independent/Monthly reviews were also very important, because they helped define issues, established overviews of the project, and allowed for appropriate and helpful recommendations for changes. Establishing the priority of the project and the development of MOUs or MOAs to clarify responsibilities and objectives were also seen as important forms of

support. Unfortunately, a healthy number of respondents also felt they had little to no support from senior management.

Aside from provided the staff, facilities and funding necessary for the project, there were two distinct areas which senior management can develop that many feel would be helpful. The first is communication and involvement. There seems to be a need for more senior management involvement with other senior managers, to help in overcoming inter-center difficulties, and senior management coordination and agreement on how the projects will be conducted, with clear expectations for each center defined. Senior management visits to facilities, to see progress and meet the people working the projects, would be seen as very constructive and helpful support. Guidance and advice would also be appreciated by many. Specifically, the clear definition of roles and responsibilities, and more advice on whether or not they are going in the right direction. Part of this from of support would come in advocacy from senior management at the HQ level.

Collaboration

Collaboration 1. Proactive program manager.

Collaboration 2. Steering Group Committee meetings.

Collaboration 3. The total lack of support from senior management was a very strong theme.

Collaboration 6. Strong senior management support, supported by the Administrator

Collaboration 7. While there was no consistent theme in the type of support received, most felt their project did receive support.

Collaboration 10. Support varied by Center. Good support at Center F, and Center B, not supported at Center J

Collaboration 11. Consistent and public verbal support, and clearly defined roles and responsibilities.

Collaboration 12. Senior management did not micromanage. (mentioned by almost all respondents).

Collaboration 13. There was advocacy for the project at HQ and funding was found.

Collaboration 16. Good support from both centers, specifically with staffing.

Center

Center B. Most felt adequately supported although there was no distinct trend in how they were supported.

Center C. While there were no strong negative answers to this question, most felt that upper management had been indifferent, as opposed to supportive.

Center D. Most felt adequately supported although there was no distinct trend in how they were supported.

Center E. While a few felt supported, the majority clearly felt the lack of support very keenly.

Center F. This groups' responses were fairly evenly split between the very positive and the very negative.

Center G. Senior management was largely seen as giving good support in several different forms including, staffing, funding, and verbal encouragement.

Center H. Most felt adequately supported, with the most common form of support being funding.

Center J. Several forms of support were mentioned, but the strongest trend was the lack of micromanagement.

What were some of the *problems* resulting from team dynamics, or the working relationships between different teams in the collaboration?

The strongest trend in answers to this question was communication. Some had complex communications systems, making the attempt to communicate far too time consuming. More face-to-face communication was seen as necessary to better understand co-workers. People were sometimes cut off from the information flow and as a result became ineffective. There were miscommunications on expected deliverables, and changes in reporting formats that became time consuming and cumbersome.

Personality differences and difficult personalities were a close second as a problem. When egos were allowed to dominate, it created a number of problems for a number of people, making it much more difficult to collaborate. As one respondent stated, "the arrogance of a number of very bright people can be very disruptive."

Competition between centers and the lack of trust between groups were also a highly distinct trend, where the willingness to commit to the collaborative effort was missing. When this existed, there was a resistance to common processes, or face-to-face meetings where issues

could be resolved. Unclear responsibilities and objectives were listed by many as creating problems.

Collaboration

Collaboration 1. Personality conflicts.

Collaboration 2. There were many people who mentioned "us vs. them" dynamics, as well as the difference in agendas and priorities between the non-NASA entity, NASA, and the contractor.

Collaboration 3. Different objectives, mistrust, and groups cut off from information flow.

Collaboration 4. Different cultures and expectations led to friction between team members.

Collaboration 5. Personalities "drove many things and created problems", communication was a problem, as were unclear roles and responsibilities.

Collaboration 6. Communication and competition between non-NASA entities and NASA.

Collaboration 7. Differences in processes.

Collaboration 9. There seemed to be a lack of willingness to truly collaborate between Collaboration 9 labs, leading to an unwillingness to compromise or share information, a lack of harmony, and poor communications.

Collaboration 11. Problems for this group were miscommunication, strong personalities, and a lack of trust.

Collaboration 12. Contractor was not fully committed.

Collaboration 13. Unclear roles and responsibilities and different purposes.

Collaboration 16. Cultural differences led to misunderstandings, and staff turnover was difficult.

What were some of the *assets* resulting from team dynamics, or the working relationships between different teams in the collaboration?

Knowledge was the most popular response to this question. That NASA can bring together a huge amount of talent makes it possible to have all the expertise required for success. The access to expertise affords the opportunity for new ideas, new perspectives, and new ways of doing things that can result in a better final product, and an enhanced scientific capability. This

was especially apparent when there was adequate face-to-face interaction between team members.

Many gained a better understanding and appreciation of NASA as a whole, of different centers and groups, and of different points of view. Strengthened personal relationships were also seen as an important asset. Networking with peers and forming good relationships was seen as key in enhancing the collaborative process.

Collaboration

Collaboration 2. Different perspectives, ideas, and knowledge contributing to unique solutions.

Collaboration 3. This group came to better understand and appreciate the professionalism of people from other centers, how other centers function, and NASA as a whole.

Collaboration 4. Better solutions because of the mix of people and expertise.

Collaboration 5. There were better solutions because of the dynamic mix of people, ideas, and disciplines.

Collaboration 6. Creation of a new, multi-university graduate program.

Collaboration 7. Understanding of, and respect for, peers from other centers. The team bonded, trust was established and there was very good teamwork.

Collaboration 9. A lot of expertise available.

Collaboration 10. There were many positives listed, but the consistent theme was that this project provided the bases for a working relationship that extends beyond this project.

Collaboration 12. The ability to do joint work in the future due to good relationships and trust established in this project.

Collaboration 13. The combined experience from 3 organizations provided quicker solutions.

Collaboration 16. Excellent problem solving ability with this team and its different perspectives.

Center

Center D. The personal relationships developed and the renewed respect for peers.

Center E. Team dynamics, such as understanding or mutual appreciation of professionalism and capability at other centers.

Were the characteristics and personalities of team leaders and team members taken into consideration and managed at an appropriate level? Please explain.

The majority of respondents replied that characteristics and personalities were managed at an appropriate level. However, nearly a third did not think this kind of management occurred. A few answered that sometimes there was appropriate management and sometimes there was not, or that it was luck and not management that kept these dynamics from being disruptive. Another set of respondents answered that either they weren't sure or that it was never really seen as an issue.

Collaboration

Collaboration 1. Yes – were managed at an appropriate level.

Collaboration 2. This group was very divided in their answers. Some felt personalities were managed well, some not at all

Collaboration 3. Any management that occurred on this project was seen as occurring through luck or happenstance.

Collaboration 4. Yes – were managed at an appropriate level.

Collaboration 5. In some cases the answer was yes, in others, most definitely not.

Collaboration 6. This group was as evenly divided as the overall population of respondents into yes, no, or by luck, roughly by thirds.

Collaboration 7. Yes – were managed at an appropriate level.

Collaboration 8. Half said that personalities were managed well, half said they were not.

Collaboration 9. The answer for this group was an overwhelming "No".

Collaboration 10. Yes – were managed at an appropriate level.

Collaboration 11. The answer here seems to be that initially personalities were not managed well, but that they are now.

Collaboration 12. Yes – were managed at an appropriate level.

Collaboration 13. This was either not seen as much of a factor, or that there was a need for much better management.

Collaboration 14. Yes – were managed at an appropriate level.

Collaboration 15. Yes and No were split evenly.

Collaboration 16. The overall answer to this question is "Yes", although several felt that it was luck.

Center

Center A. Only 2 respondents, evenly split between yes and don't know.

Center B. Yes, were managed well.

Center C. Yes, were managed well.

Center D. Most said yes.

Center E. Most said no, or not always effectively, and a couple said yes.

Center F. Split almost equally between yes, no, or by luck/don't know, with slightly

Center G. Mostly yes, a couple of respondents said no, or over time it became better.

Center H. Split response between yes, no, or by luck/don't know.

Center I. Only 2 respondents, evenly split between yes and no.

more stating that yes, were appropriately managed.

Center J. Most said yes, with a few saying personalities not well managed or they weren't sure.

Role

The most interesting trend here is not necessarily that of one group, but in the comparison of the groups. Line Workers had a much higher proportion of positive answers (about 2/3), believing that personalities were well managed, and very few negative answers. Middle and upper management levels had answers that were almost equally distributed between positive and negative replies.

What were some of the problems created by a difference in *organizational culture* between team members? Please explain.

The most frequent response to this question was a lack of appreciation and respect for each other's capabilities and knowledge. In some cases, different center experts wouldn't even talk to each other. Arrogance and feelings of superiority, on either the center or individual level, created major roadblocks in the collaborative process.

When different organizations had different agendas, there were problems. This existed not only on the center to center level, but was also mentioned as a problem when there were different motivations for government, industry, and academia for participating in a collaboration. Some explained this as the difference between an organization whose goals are scientific vs. an

organizations whose goals are financial. There were also problems with competition between organization, where fighting turf wars and a lack of trust led to a lack of commitment to the collaboration.

Unclear procedures, roles, and responsibilities were also an important theme. There were different ways of doing business that led to misunderstandings about various aspects of collaborations, different funding processes, different levels of formality embedded in processes, different expectations for processes, and different schedules, all of which impeded progress. The lack of understanding involved when there were different frames of reference was its own theme, but can clearly be traced to all of the above.

There was also one highly specific theme worth noting. Within NASA collaborations, contractors are often treated with a lack of respect, as "second class citizens" which is very demoralizing and leads to high levels of frustration, making collaboration more difficult.

Collaboration

There were no distinct trends that differed from the overall perspective in the breakdown by collaboration. For each group, there were a variety of answers.

Center

Center G. The difference in formality levels between centers.

Center I. A lack of uniformity in processes.

What are the top 2 or 3 elements that have *contributed* to the collaboration's success?

This set of responses can be roughly grouped into four categories; elements that occur on the project level, elements that have to do with shared ideals, those that are particular to individual qualities, and those relating to working with others. On the project level, communication was the most frequently listed; specifically face-to-face meetings, and communications systems, such as WebEx and NEXPRISE. Clear goals and objectives were major contributors to success, as was "support from the top." Other elements mentioned in this category were: knowing what expertise is available and having access to it; the freedom to manage and choose the working team; the flexibility of the team; management willing to act as a liaison and attack problems; a commitment to regularly scheduled meetings; travel funding;

concern for members of the team; and even-handed decision making. Also mentioned was that good science data and results, and success on the project, bred further success on the project.

Within the grouping of shared ideals, the most common element contributing to success were common goals and objectives. A willingness at the group level, to communicate and share knowledge, power, and decision-making were very positive elements, as was an agency (as opposed to center) approach that fostered team-work.

There were many elements listed that had to do with the individuals working on the collaborative effort. Enthusiasm, the desire to succeed, and a "can do" attitude, along with expertise and talent, topped the list. Commitment to the project, pride in their work, openness, honesty, and the willingness to take personal responsibility were all elements contributing to success.

When working with others, the most positive elements were respect and trust, allowing for the foundation of personal relationships. If people had worked together before and were familiar with each other, this was seen as a bonus that contributed to the collaborative effort.

Collaboration

Collaboration 2. The quality of the people involved.

Collaboration 4. Good people who are valued and supported,

Collaboration 6. Commitment and support from top levels of all organizations.

Collaboration 9. Enthusiasm for the work/goals of the project.

Collaboration 11. Significant face-to-face meetings.

Collaboration 12. Common goals and the commitment of the team.

Collaboration 14. The expertise available.

Collaboration 16. Common goals and good people on the project.

What are the top 2 or 3 elements that have *inhibited* the success of this collaboration?

These responses, as with the previous question, can be grouped into several categories; elements occurring at an Agency-wide level, the project level, and as cultural issues. At an agency level, the lack of leadership and direction from HQ inhibited collaboration, as did the lack of agency sponsorship. Communication difficulties were the most common inhibitors mentioned. The lack of face-to-face meetings, the distance between team members, the

differences in time zones, and general communication breakdowns were all mentioned as inhibiting collaboration success.

On the Project level, budgetary constraints were most frequently mentioned. Specific budgetary inhibitors were: the chaotic nature of the funding system, competition for funds, the perceived increased cost of a project, and full cost accounting. Different goals and objectives, as well as different agendas and priorities created problems, as did unclear roles and responsibilities. Also mentioned were: personnel not being assigned when needed, the lack of science integration, the formality of processes taking up time and energy, a lack of reviews and follow-up meetings, and a lack of recognition and support.

The primary cultural issue that inhibited success was the lack of trust and respect, leading to an unwillingness to work cooperatively. Other cultural issues were selfishness and self-interest, a lack of commitment, a lack of buy-in from partners, turf protection, and an unwillingness to share either knowledge or power.

Collaboration

Collaboration 3. Lack of upper management support. Lack of management support at the center level.

Collaboration 5. Different cultures and a lack of trust.

Collaboration 6. Funding issues: non-NASA entities concerned that grant money will dry up, the center concerned about cost, and concern about receiving benefit proportional to funding input.

Collaboration 7. Changing/unsteady budget and turf protection.

Collaboration 9. Competition between labs, lack of trust, and ego.

Collaboration 10. Lack of clear communication

Collaboration 16. The need more face-to-face communication.

How was teamwork included in your performance plan?

This set of responses was equally divided into three kinds of answers. Approximately one third of respondents stated simply that teamwork is not included in their performance plan. When teamwork was included in the performance plans of respondents, it was usually included as a performance element. It was also included as a general performance standard, in leading the development of a partnership ("which is teamwork"), in terms of teamwork between resources

and the science community, or as how well a respondent communicated, their ability to solve problems, and the ability to collaborate with people on different projects.

There other third (approximately) of respondents indicated that, while not specifically a part of their performance plan, teamwork was implied. They saw this clear implication as stemming from several factors: performance of their job requires teamwork; teamwork is required in order to be successful in promotions and recognition; or their job centers around actions that *are* teamwork.

Collaboration

Collaboration 1. Included as part of their working role (i.e., as project manger, working with other leads)

Collaboration 2. For approximately half, it was a performance element, for the other half, it was not specifically included.

Collaboration 3. Minimally or not at all.

Collaboration 4. Not included specifically.

Collaboration 5. For most, but not all, was part of their performance plan.

Collaboration 6. For most it was a strongly implied part of their plan, but not specifically included.

Collaboration 7. Equally divided between yes, and not specifically, with one not at all.

Collaboration 8. Not specifically in plans.

Collaboration 9. Most are implied but not specific parts of the performance plan.

Collaboration 10. Equally divided between yes, not included and implied.

Collaboration 11. For most it was included.

Collaboration 12. For some this was a performance element, for others it was not specifically included.

Collaboration 13. Half as a performance element, half not included.

Collaboration 14. Not specifically included for two, but included in one.

Collaboration 15. For one, it was included, for one it was implied, for one it was not in their plan.

Collaboration 16. Equally divided between yes, not included and implied.

Center

Center A. Only two respondents, neither with a clear indication of whether or not it was in their plans.

Center B. For most it was not included.

Center C. Equally divided between included, not included, and implied.

Center D. Teamwork was included.

Center E. Evenly divided between included and not included.

Center F. For the largest proportion it was implied, followed by not included, with a couple for whom it was included.

Center G. For most, teamwork was included.

Center H. For the largest proportion it was included, followed by not included, with a couple for whom it was implied.

Center I. For two respondents, one felt it was not an issue, the other that it was implied.

Center J. Equally divided between included, not included, and implied

Questionnaire Results

The questionnaire was completed by 92 respondents from 16 different collaborations. Respondents answered 36 questions about their attitudes towards various aspects of their collaboration on a scale of 1 – 7, where a 1 indicated that they strongly agreed with the statement, a 4 indicated that they neither agreed nor disagreed with the statement, and a 7 indicated that they strongly agreed with the statement. Demographic data was also collected, including the collaboration worked on, job level (upper management, middle management, and line workers), Enterprise of the respondent, Center of the respondent, total funding for the collaboration, the number of people working on the collaboration, years allotted for the collaboration, start dates, scheduled end dates and actual end dates of the collaboration, the percent of time the respondent works on the collaboration (full time, 50%, etc.), and the length of time the respondent has spent on the collaboration.

These demographics were used either as predictor variables or to calculate predictor variables in analysis of variance tests (ANOVAs) to determine if there were any differences in scores due to the predictor variables. (In other words, were the differences between groups – such as the various collaborative efforts – meaningful, and was significant, meaning that there was very little likelihood that we would find them significant by chance). The predictor variables used were as follows: Collaboration, Job Level, Enterprise of respondent, Center of respondent, Total Project Funding, Number of People working on the collaboration, Difference Between Actual and Scheduled End Dates, Percent of Time Working on Project, Length of Time Working on Project. A description of each level of each predictor variable and the size of each level of the predictor variables is included before each analysis description. (For example, the levels of the predictor variable collaborative efforts would be the various collaborative efforts, and the size of each level would be the number of respondents from each collaboration).

Before looking at the analysis of variance depending, a summary of the overall responses to the questions will provide an overview of how respondents, as a whole, view collaborative efforts at NASA. There is a large amount of data, therefore the most simple and expeditious way to examine the data set is to first examine which items are most highly correlated with respondents' view that the collaboration has been or will be successful.

One point to be made before continuing is that it is not necessary to understand all the statistical writing to read this – you can ignore the numbers and symbols if you like. They are

included for those who are interested. If you want to ignore the actual numbers, feel free to do so. For those interested in reading the numbers, I will include brief detail as to how to do so.

Correlations with perceived success of collaborations

A correlation matrix (bivariate, two-tailed) was created to examine the levels of correlation between scores on all questions as well as with the demographic data. Most of the questions were correlated with perceived success at varying levels. *A word of caution when reading these results*: this was not an experimental design, and these are correlations, so it would be erroneous to conclude that an area with a high score *creates* success in collaborations. What we can conclude is that, if these things are highly correlated, they move hand in hand, and that a rise in one item indicates a rise (or a decline in the case of negative correlation) in the other item with which it is correlated.

That being said, items not correlated at a significant level were the demographics of: job level, center of respondent, funding for the project, years for collaboration, the percent of time (full time, 50%, etc.) the respondent works on the project, and the length of time worked on the project. These things do not appear to be related to the success of collaborations as perceived by respondents.

Reading the statistics

The number of respondents, or cases, for any given group, or level of a variable, is indicated by the letter "N". Therefore N=12 means that there were twelve cases for the item being discussed. The level of significance is indicated by the letter "p". Significance means the likelihood of finding meaningful results, given the number of responses and the sizes of the various groups, purely by chance. Therefore, if $p < .05$, that means that these results would be found fewer than 5 times in 100 purely by chance, indicating that these results are highly unlikely to be found unless they existed in a meaningful way. (If $p < .01$, then the only 1 times in 100 would this be found by chance, and if $p < .001$, then only 1 times in 1000 would this be found by chance.)

The letter that indicates the strength of the correlation is "*r*". This correlation coefficient tells us how strongly two things are correlated, and the scale of correlation is 0 – 1. A correlation of 0 means that two items are not at all correlated. A correlation of 1 means that two items are perfectly correlated. It is also possible to have a negative correlation, which means that

as one item goes up, the other goes down. The number associated with the correlation coefficient tells us how *much* the two items are correlated (or what the shared variance is, or, very simply, how much area they have in common). Therefore, $r = .727$ (or $r = -.727$) indicates a very high level of correlation, or commonality, whereas $r = .171$ indicates a very low level of correlation. It is also important to note that the strength of the correlation is not the only item of importance. Two items can be correlated at a low but significant level. As an example, teams having access to necessary expertise had a relatively low correlation (r - .276) with the perceived success of the collaboration, however, that correlation was still statistically significant, which means that even though an increase in access to expertise would only indicate a correlated increase in perceived success at a relatively small level, the increase would occur and would have a meaningful impact on the perceived level of success (or that success has a meaningful impact on access to expertise).

The strongest correlations - $p < .01$

The items most strongly correlated with the perceived success of the collaborations are all significant at $p < .01$ and are listed in descending order of the correlation coefficient (r), which indicates the degree of correlation. Negative correlations indicate that as one part of the correlation goes down, the other goes up, thus for questions where a high score indicates agreement with a negative statement, lowering the negative should result in an increase in the score associated with success on collaborations. Negative correlations are italicized with an asterisk preceding the correlation coefficient.

Question	**(*r*)**
Same collaboration goals	($r = .727$)
Team members were invested in collaboration and outcomes	($r = .684$)
High level of trust between members	($r = .669$)
Strong team identity	($r = .661$)
An "us vs. them" attitude	*$(r = -.633)$
Allocation of responsibility built into process and evenly distributed	($r = .620$)
Control equally distributed	($r = .599$)
Funding fairly distributed	($r = .596$)
Team members were chosen appropriately	($r = .587$)
There were effective metrics to measure success	($r = .580$)
Goals were appropriate and realistic	($r = .559$)
Recognition from superiors	($r = .537$)
Successes of the team were acknowledged	($r = .523$)

Distribution of funding strained relationships	*(r = -.518)*
Completed within budget	(r = .496)
Unclear responsibilities negatively affected relationships	*(r = -.464)*
Conflicts between individuals inhibited success	*(r = -.457)*
Frequency of communication was adequate	(r = .437)
Upper management gave adequate support	(r = .389)
Completed on Schedule	(r = .383)
Adequate face-to-face interaction	(r = .382)
Successes of the team were celebrated	(r = .397)
Responsibilities were clearly defined at the start	(r = .363)
Rate of turnover presented obstacles	*(r = -.361)*
There was planning input from all parties	(r = .340)
Funding was adequate to meet project goals	(r = .321)
The schedule was realistic	(r = .306)
Enterprise of respondent	(r = .292)
Adequate administrative support	(r = .278)
Team had access to necessary expertise	(r = .276)

Significant correlations - $p < .05$

Number of people working on collaboration	(r = .250)
Members were willing to share knowledge	(r = .248)
Communication difficult because members in different locations	*(r = -.250)*
Physical locations of various team members were an obstacle	*(r = -.232)*
Inadequacy of funding strained relationships	*(r = -.230)*
Scheduling pressures inhibited ability to work together	*(r = -.215)*
The workload was reasonable	(r = .206)

Average scores on questions for the entire data set

The second step is to examine which items were viewed in a positive light, what was seen as neither particularly positive nor particularly negative, and what was viewed negatively. A note before beginning: for most answers, a high score means a positive result, however, for some questions were phrased in such a way that a higher score, while indicating strong agreement, means that the respondent strongly agreed with a negative statement. In these cases, the lower the score, the more positive the result and will be italicized. For the purposes of this review, positive results in question answers mean that the average score was between 5.5 and 7, high neutral scores averaging between 5 and 5.5, neutral scores averaging between 4 and 5,and negative scores averaging below 4. Averages are reported in descending order.

Questions receiving *positive* scores

There were only three questions which elicited a clear positive response from the group as a whole.

Question	**Average**
Collaborations were seen as being successful	(x = 5.59)
Team members chosen were appropriate	(x = 5.65)
Teams had access to necessary expertise	(x = 5.66)

Questions receiving *tending towards, but not clearly, positive* scores

Question	**Average**
People recognized by superiors	(x = 5.46)
Team members willing to share knowledge	(x = 5.38)
Realistic and appropriate goals	(x = 5.23)
Adequate frequency of communication,	(x = 5.16)
Strong team identity	(x = 5.05)
Acknowledgment of team successes	(x = 5.13)
There was planning input from all parties	(x = 5.00)

Questions receiving *neutral* scores

The majority of scores were in the neutral range.

Question	**Average**
The workload was reasonable	(x = 4.88)
There were effective metric(s) to measure success	(x = 4.87)
Adequate face-to-face interaction	(x = 4.87)
Funding was fairly distributed	(x = 4.78)
Upper management gave project adequate support	(x = 4.78)
Scheduling pressures inhibited ability to work together	**(x = 3.37)*
Team successes were celebrated	(x = 4.66)
Funding was adequate to meet project goals	(x = 4.64)
Unclear responsibilities negatively affected working relationships	*(x = 3.47)*
Project completed within budget	(x = 4.51)
The rate of turnover presented obstacles	*(x = 3.49)*
Shared collaboration goals	(x = 4.49)
High levels of trust between member	(x = 4.44)
Project completed on schedule	(x = 4.40)
Schedule was realistic	(x = 4.39)
The distribution of funding strained relationships	*(x = 3.65)*
Allocation of responsibility built into procedure and applied evenly	(x = 4.33)

Responsibilities clearly defined at the start	(x = 4.24)
Physical location was an obstacle	(x = 4.23)
Control was equally distributed	(x = 4.17)
Inadequacy of funding strained working relationships	*(x = 3.83)*
Conflicts inhibited success	*(x = 3.90)*
There was an 'us vs. them' attitude	*(x = 3.95)*
Communication was difficult due to different locations	*(x = 4.00)*

Questions receiving *negative* scores

There was only one question received a below neutral score of 4 when the data was looked at for the entire group: adequate administrative support (x = 3.90).

Analysis of Variance – looking at the data by predictor variables

The analysis of variance tells us if there are significant differences between groups on the questionnaire items. It tells us if the differences in the scores for each group within a variable (such as each individual collaborative effort representing a level of the variable collaboration), are meaningful and not likely to be found by chance. While it would be very rare for there to be no difference in the average of scores of different groups, the differences in the scores might not always tell us anything important. If the difference is statistically significant, then those differences are important and meaningful.

For example, did it make a significant difference as to whether the collaboration was perceived as successful, depending on which collaboration the person was working on (or what center they come from)? As previously mentioned, each predictor variable, the levels of each predictor variable, and the number of cases for each level are listed before each summary of individual analysis of variance results.

Reading the statistics

The level of significance (p) and how to read the numbers related to it are covered in the "Correlations with perceived success of collaborations" section. The only other statistical shorthand used in this section is the letter "x", which represents the average score for a given level of a group and the Greek symbol "μ", which represents the "grand mean", or the average of all scores combined, which includes all levels of all groups. Therefore, x = 4.00 means that the average score for the group or item being discussed is 4.00 (and all numbers will be between 1 and 7, as a 1 – 7 scale was used in the questionnaire).

For example, we could (and do) look at whether or not there are differences in the scores of respondents to the question of whether or not the collaboration was seen as successful, depending on which collaboration the respondent was working on and we see that the differences were both significant and meaningful ($p < .05$). We would then look at the average of the scores for respondents from each collaborative effort to see what the average scores were ($x = 3.56$ for collaboration A, $x = 5.67$ for collaboration B). This would indicate that these differences are meaningful, not likely to be found by chance, and that collaborative effort B saw their effort as more successful than collaborative effort A. The significance level (p) tells us whether the differences are meaningful, the average scores tell us the beginning of the story of why those scores are meaningful, i.e. which groups have relatively high or low scores in relation to each other.

Differences by Collaboration

These results give a picture of what the strengths and weaknesses are in each collaboration examined. The most salient aspect of these results is that they indicate that the more of the elements that had positive results, the more successful the collaborations tended to be. It is also interesting to note how strengths and weaknesses offset each other in each collaboration, especially those with more neutral scores for the overall success of the collaboration.

There were significant differences between collaborative efforts on all but one question, whether the teams had access to necessary expertise. (In fact, the majority of questions had differences significant at $p < .001$). This portion of the report will cover what each project saw as strengths and weaknesses, where positive scores for any item average (for the collaboration) above 5, and negative scores average below 3.70. Any item with an average score between 3.7 and 5 is not included in this portion of the report. There is enough information in this one analysis of variance for an entirely separate report, therefore I have attached a Means table as Appendix B, so that each collaboration can be viewed in more detail by anyone choosing to do so.

Collaboration 1 *(n=3)*

There were only 3 respondents from this collaboration, therefore, keep in mind that this is the average of three people's attitudes only, and thus a limited picture of this collaborative effort which is not definitive.

Positives. The Collaboration 1 group saw the collaboration as very successful (x = 6.33) and being completed on schedule (x =5.00). Team members were willing to share knowledge (x = 6.00) and those chosen were appropriate (x = 5.33), turnover did not present a problem *(x = 2.33) and there was a clear and strong sense of team identity (x =5.00). The goals were realistic (x = 5.33), the workload was reasonable (x = 5.00), there was access to necessary expertise (x = 5.67), and adequate recognition of work from superiors (x = 5.00).

Negatives. This group did not see control over the collaboration as being equitably distributed (x =3.00), and the distribution of funding strained working relationships *(x = 2.00). They also did not think that responsibilities of all team members were clearly defined at the start of the collaboration.

Collaboration 2 *(n = 7)*

Positives. Overall, the collaboration was seen as successful (x = 5.43), and there were effective metrics to measure success (x = 5.14). Planning involved input from all parties (x = 5.00), and there were not unclear responsibilities *(x = 2.71). Funding for the collaboration was adequate (x = 5.57) and was equitably and fairly distributes (x = 5.29), the distribution did not strain working relationships (x = 2.86).

The team members chosen were seen as appropriate (x = 5.86), the team had access to necessary expertise (x = 6.00), team members were willing to share knowledge (x = 5.57), there was a strong and clear team identity (x = 6.29), and team members were invested in the collaboration (x = 5.57). There was an adequate amount of face-to-face interaction (x = 5.86) and the frequency of communication was also adequate (x = 5.29). Communication was not difficult due to location differences *(x = 2.71), nor were the physical location of team members an obstacle *(x = 2.43).

Negatives. The project is not being completed on schedule (x = 2.14), members of the team did not have the same collaboration goals (x = 3.57), there was a strong "us vs. them" attitude *(x = 3.57), and a low level of trust between members (x = 3.43). There was not adequate recognition from superiors (x = 3.71), successes of the team were not celebrated (x =

3.00), nor were they acknowledged (x = 2.86). The schedule was not seen as being realistic (x = 3.00), and control was not equitably distributed (x =3.57). Communication was difficult because team members were in different locations (x = 5.29) and the physical location of various members was an obstacle *(x = 2.43). Unclear team member/partner responsibilities negatively affected their working relationships *(x = 2.71).

Collaboration 3 *(n = 6)*

This collaboration was seen as least successful by its members (x = 2.00). There were no positive scores averaging 5 or above.

Negatives. There were no effective metrics to measure success (x = 3.33) and the collaboration is not being completed within its budget (x = 2.50). The rate of staff turnover was a problem *(x = 5.00), control over the collaboration was not equally distributed (x = 1.83), and the goals were not appropriate or realistic (x = 3.67). Unclear team member responsibilities negatively affected working relationships *(x = 5.17) and allocation of accountability was not built in to the collaboration procedure (x = 2.33). Funding was neither adequate (x =2.33), nor fairly distributed (x = 2.83) and its distribution strained working relationships *(x = 6.33). The team members chosen were not appropriate (x = 3.50) and the collaboration involved an "us vs. them" attitude *(x = 6.17). Individual conflicts inhibited success *(x = 5.00), and team members were not invested in the collaboration (x = 3.17). There was not adequate recognition of work or responsibilities (x = 3.00), successes of the team were not acknowledged (x = 2.67) or celebrated (x = 3.00). There was not adequate administrative support for team members (x = 2.83), nor did upper management five the collaboration adequate support (x = 1.83).

Collaboration 4 *(n = 2)*

There were only 2 respondents from this collaboration, therefore, keep in mind that this is the average of two people's attitudes only, and therefore a very limited picture of this collaborative effort which is not definitive.

Positives. The collaboration is seen as successful (x = 6.00) with effective metrics for measuring success (x = 5.50). Control was equitably distributed (x = 5.50), the workload was reasonable (x = 5.50), and the funding was adequate (x = 5.50), and fairly distributed (x = 5.50). Team members chosen were appropriate (x = 6.00), had access to expertise (x = 6.00), and were

willing to share knowledge (x = 5.00). There was a high level of trust between team members (x = 6.00), who were invested in the collaboration (x = 5.50). There was adequate face-to-face interaction (x = 5.50) and the frequency of communication was adequate (x = 5.50). There was adequate recognition of work and responsibilities (x = 6.50), and successes of the team were acknowledged (x = 6.00) and celebrated (x = 6.00). There was adequate administrative support for team members (x = 5.00).

Negatives. The collaboration is not being completed on schedule (x = 2.00), the schedule was unrealistic (x = 3.00), and it is not being completed within its budget (x = 2.50). The collaboration had an "us vs. them" attitude *(x = 5.00), and there were conflicts between individuals that inhibited success (x = 5.00).

Collaboration 5 *(n = 6)*

This collaboration was not seen as being either successful or unsuccessful (x = 4.67)

Positives. The collaboration is within its budget (x =5.00), staff turnover did not present obstacles *(x = 3.00), and the workload was reasonable (x = 5.00). The team members were appropriately chosen (x =5.67) and had access to necessary expertise (x = 5.67). There was adequate recognition (x =5.50), and successes of the team were acknowledged (x = 6.00) and celebrated (x = 6.00). Upper management gave the collaboration an adequate amount of support (x = 5.67).

Negatives. The collaboration is not on schedule (x = 3.33), and control was not equitably distributed (x = 3.33). Allocation was not built in to the collaboration (x = 3.33), funding was not adequate (x = 3.33), and the distribution of funding strained working relationships *(x = 5.50). There was not trust between team members (x = 3.17), members of the team did not have the same goals (x = 3.33), and individual conflicts inhibited collaboration *(x = 6.00). There was not adequate face-to-face interaction (x = 3.67) and the physical location of team members was an obstacle *(x = 5.67).

Collaboration 6 *(n = 8)*

This was seen as a successful collaboration (x = 6.50)

Positives. There were effective metrics to measure success (x = 6.00), it is on schedule (x = 5.75), within budget (x = 6.13), and the schedule was realistic (x = 5.50). Staff turnover did

not present obstacles *(x =2.00), and control was equitably distributed (x = 5.25). Planning involved input from all parties (x = 5.88), and the goals were appropriate and realistic (x = 5.00). The workload was reasonable (x = 5.00), responsibilities were clearly defined at the start (x = 5.00), unclear responsibilities did not present problems *(x =3.25), and allocation of accountability was built in to the collaboration (x = 5.13). Funding was adequate (x = 5.13), equitably distributed (x = 5.63), inadequacy of funding did not strain relationships *(x =3.00), nor did its distribution *(x = 3.00). Team members were appropriately chosen (x = 6.50), had access to expertise (x = 6.50), were willing to share knowledge (x = 6.38) and had a strong team identity (x = 5.75). The collaboration did not have an "us vs. them" attitude *(x = 2.63), there was a high level of trust (x = 5.00), individual conflict did not inhibit success *(x =2.63), and team members were invested in the collaboration (x = 6.00). There was an adequate amount of face-to-face interaction (x = 6.00), the frequency of communication was adequate (x = 6.00), and the physical location of team members did not present obstacles *(x = 2.13). There was adequate recognition (x = 6.43), and successes were acknowledged (x = 5.75) and celebrated (x = 5.00). Upper management gave the collaboration adequate support (x = 6.00).

Negatives. None below average of 3.5.

Collaboration 7 *(n = 9)*

The Collaboration 7 collaboration was seen as being neither successful or unsuccessful (x = 4.44)

Positives. Team members were chosen appropriately (x = 5.78), were willing to share knowledge (x = 5.00), and were invested in the collaboration (x = 5.67). Upper management was seen as giving adequate support (x = 5.00).

Negatives. There were not effective metrics to measure success (x = 3.65) and the schedule was not realistic (x = 3.22). Control was equitably distributed (x = 3.11), and planning did not involve all parties (x = 3.67). The workload was not reasonable (x = 3.56), responsibilities were not clearly defined at the start (x = 3.22), and the members of the team did not have the same goals (x = 3.89). There was not adequate administrative support for team members (x = 3.00).

Collaboration 8 *(n = 5)*

Collaboration 8 was seen as a successful collaboration (x = 6.40)

Positives. The collaboration is on schedule (x = 5.60) and within its budget (x = 5.60). Staff turnover did not present obstacles *(x = 2.20). The goals were realistic (x = 5.80), and the workload was reasonable (x = 5.00). Team members were appropriate (x = 5.80), had access to necessary expertise (x = 6.00), were willing to share knowledge (x = 5.80), and were invested in the collaboration (x = 5.60). There was adequate recognition of work and responsibilities (x = 6.40).

Negatives. Conflicts between individuals inhibited success (x = 5.00), there was not an adequate amount of face-to-face interaction (x = 3.40), and successes were not celebrated (x = 3.00).

Collaboration 9 *(n =5)*

The Collaboration 9 collaboration was seen as being neither successful or unsuccessful (x = 4.00)

Positives. There was adequate recognition of work and responsibilities from superiors (x = 5.00)

Negatives. There were not effective metrics to measure success (x = 2.20), the collaboration is not on schedule (x = 3.20) and the schedule was not realistic (x = 3.60). Staff turnover created obstacles *(x = 6.00), and control was not equitably distributed (x = 2.80). Responsibilities were not clearly defined at the start (x = 2.60), unclear responsibilities negatively affected working relationships *(x = 5.00), and allocation of accountability was not built in to the collaboration and applied equitably (x = 2.80). Funding was not equitably distributed (x = 3.60), and its distribution strained working relationships *(x = 5.00). Team members were not appropriate (x = 2.40), were not willing to share knowledge (x = 2.00), and did not have trust (x = 2.60). There was not a clear team identity (x = 2.40), there was and “us vs. them” attitude *(x = 5.00), and team members did not share the same goals (x = 1.60). There were personal conflicts that inhibited success *(x = 5.80), and team members were not invested in the collaboration (x = 2.00). There was not adequate face-to-face interaction (x = 2.00), and the frequency of communication was not adequate (x = 3.20). Successes of the team were not celebrated (x = 3.20), there was not adequate administrative support (x = 2.75) and upper management did not give the collaboration adequate support (x = 2.80).

Collaboration 10 *(n = 12)*

Collaboration 10 was seen a very successful collaboration (x = 6.75)

Positives. There were effective metrics to measure success (x = 5.75), the collaboration is on schedule (x = 6.33), within its budget (x = 5.64), and the schedule was realistic (x = 6.00). Scheduling pressures did not inhibit the team's ability to work together *(x =2.75), and the rate of turnover did not present obstacles *(x = 2.91). Control was equitably distributed (x = 5.00), planning involved input from all parties (x = 5.58), goals were realistic (x = 6.25), and workload was reasonable (x = 5.75). The responsibilities of team members were clearly defined at the start (x = 5.36), unclear responsibilities did not negatively affect working relationships *(x = 2.00), and allocation of accountability was built in to the collaboration procedure (x = 5.18). Funding was adequate to meet goals (x = 5.00) and its distribution did not strain working relationships *(x = 2.75).

Team members were appropriately chosen (x = 6.33), had access to necessary expertise (x = 6.08), were willing to share knowledge (x = 6.25), and had the same goals (x = 6.00). There was a strong team identity (x = 5.92), there was not an "us vs. them" attitude *(x = 2.75), there was a high level of trust (x = 5.55), and personal conflicts did not inhibit success *(x = 2.75). There was an adequate amount of face-to-face interaction (x = 5.75), adequate frequency of communication (x = 6.00), communication was not difficult because of differing locations *(x = 3.50), and the physical location of team members were not an obstacle *(x = 3.45). There was adequate recognition (x = 6.42), successes were acknowledged (x = 6.50) and celebrated (x = 5.75), and upper management gave the collaboration adequate support (x = 5.58).

Negatives. None below average of 3.5.

Collaboration 11 *(n = 5)*

The success of this collaboration had an average score of 5.40.

Positives. Control was equitably distributed (x = 5.00). Team members chosen were appropriate for the project (x = 5.80), had access to expertise (x = 5.60), were willing to share knowledge (x = 5.20), and were invested in the collaboration (x = 5.20). There was adequate recognition of work and responsibilities (x = 6.20), successes were acknowledged (x = 5.60), and upper management gave the collaboration adequate support (x = 5.40)

Negatives. The collaboration is not on schedule (x = 2.40), is not within budget (x = 1.40), the schedule was not realistic (x = 2.40), and scheduling pressures inhibited the team's ability to work well together *(x = 5.60). Staff turnover presented obstacles *(x = 5.80), planning did not involve input from all parties (x = 2.60), and the workload was unreasonable (x = 3.20). Responsibilities of team members were not clearly defined at the start of the collaboration (x = 2.20), and allocation of accountability was not built in to the collaboration procedure (x = 3.60). Funding was not adequate to meet collaboration goals (x = 2.80). There was an "us vs. them" attitude *(x = 6.00), a lack of trust between team members (x = 3.20), and individual conflicts inhibited success *(x = 5.40). Communication was difficult because team members were in different locations *(x = 6.00), and the physical locations of team members was an obstacle *(x = 5.60). There was not adequate support for team members by including collaboration work in performance plans, etc. (x = 3.60).

Collaboration 12 *(n = 7)*

This was seen as a successful collaboration by respondents (x = 6.57)

Positives. There were effective metrics to measure success (x = 5.75), the collaboration is on schedule (x = 6.33), within its budget (x = 5.64), and the schedule was realistic (x = 6.00). Scheduling pressures did not inhibit the team's ability to work together *(x =2.75), and the rate of turnover did not present obstacles *(x = 2.91). Control was equitably distributed (x = 5.00), planning involved input from all parties (x = 5.58), goals were realistic (x = 6.25), and workload was reasonable (x = 5.75). The responsibilities of team members was clearly defined at the start (x = 5.36), unclear responsibilities did not negatively affect working relationships *(x = 2.00), and allocation of accountability was built in to the collaboration procedure (x = 5.18). Funding was adequate to meet goals (x = 5.00), its distribution did not strain working relationships *(x = 2.75), nor did inadequacy of funding strain relationships (x = 1.71).

Team members were appropriately chosen (x = 6.71), had access to necessary expertise (x = 6.00), were willing to share knowledge (x = 6.57), and had the same goals (x = 5.86). There was a strong team identity (x = 6.00), there was not an "us vs. them" attitude *(x = 2.86), there was a high level of trust (x = 5.71), and personal conflicts did not inhibit success *(x = 2.14). Team members were invested in the collaboration (x = 6.57). There was an adequate amount of face-to-face interaction (x = 5.57), adequate frequency of communication (x = 6.14), and the

physical location of team members were not an obstacle *(x = 2.71). There was adequate recognition (x = 5.67), successes were acknowledged (x = 6.29) and celebrated (x = 5.29), there was adequate administrative support for team members (x = 5.29), and upper management gave the collaboration adequate support (x = 5.71).

Negatives. None below average of 3.5.

Collaboration 13 *(n = 4)*

There were only 3 respondents from this collaboration, therefore, keep in mind that this is the average of three people's attitudes only. The success of this collaboration had an average score of 5.50.

Positives. There were effective metrics to measure success (x = 5.50) and the schedule was realistic (x = 5.75). The staff turnover rate did not present obstacles *(x = 2.67), planning involved input from all parties (x = 6.25), the goals were realistic (x = 6.25), the workload was reasonable (x = 6.25), responsibilities were clearly defined at the start (x = 5.25), and allocation of accountability was built in to procedure (x = 5.00). Funding was adequate to meet goals (x = 5.75). Team members had the same goals (x = 5.00), and individual conflicts did not inhibit success *(x = 3.00). There was adequate recognition (x = 6.00), and adequate administrative support for team members (x = 5.50).

Negatives. The collaboration is not on schedule (x = 2.25) and not within its budget (x = 3.25). Team members were not willing to share knowledge (x = 3.50). The frequency of communication was not adequate (x = 3.00), and communication was difficult because of team members' different locations *(x = 6.25).

Collaboration 14 *(n = 6)*

This was seen as a successful collaboration (x = 6.33)

Positives. There were effective metrics to measure success (x = 5.83), the collaboration is on schedule (x = 5.50), within its budget (x = 5.17), and the schedule was realistic (x = 5.50). Scheduling pressures did not inhibit the team's ability to work together *(x =2.67), and the rate of turnover did not present obstacles *(x = 2.00). Control was equitably distributed (x = 5.00), planning involved input from all parties (x = 5.67), goals were realistic (x = 5.83), and workload

was reasonable (x = 5.00). Allocation of accountability was built in to the collaboration procedure (x = 5.67). Funding was equitably distributed (x = 5.67).

Team members were appropriately chosen (x = 5.83), had access to necessary expertise (x = 5.83), were willing to share knowledge (x = 6.33), and had the same goals (x = 6.17). There was a strong team identity (x = 6.17), there was not an "us vs. them" attitude *(x = 2.00), there was a high level of trust (x = 5.83), and personal conflicts did not inhibit success *(x = 2.67). Team members were invested in the collaboration (x = 6.50). There was an adequate amount of face-to-face interaction (x = 6.00), and adequate frequency of communication (x = 6.00). There was adequate recognition (x = 5.67), successes were acknowledged (x = 5.83) and celebrated (x = 5.33).

Negatives. Unclear responsibilities of team members negatively affected working relationships *(x = 5.00).

Collaboration 15 Team *(n = 1)*

There was only one respondent from this team who filled out a questionnaire. Therefore it would be misleading to present findings for the collaboration based on a sole individual's perceptions. However, this one respondent's scores can be seen in the Means Table (Appendix D).

Collaboration 16*(n = 6)*

This was seen by respondents as a successful collaboration (x = 6.67)

Positives. There were effective metrics to measure success (x = 5.67), and scheduling pressures did not inhibit the team's ability to work well together *(x = 2.83). Control was equitably distributed (x =6.00), planning involved input from all parties (x = 5.83), goals were realistic (x = 6.00), and the workload was reasonable (x = 5.50). Unclear responsibilities did not negatively affect working relationships *(x = 2.67), and allocation of accountability was built in to the collaboration procedure (x = 5.33). Funding was adequate to meet goals (x = 5.17), was equitably distributed (x = 5.83), and neither the distribution *(x = 2.00), nor inadequacy *(x = 2.67) of funding strained working relationships.

Team members were appropriately chosen (x = 6.33), had access to necessary expertise (x = 5.83), were willing to share knowledge (x = 6.17), and had the same goals (x = 5.83). There

was a strong team identity (x = 6.00), a high level of trust (x = 5.83), and personal conflicts did not inhibit success *(x = 2.67). Team members were invested in the collaboration (x = 6.67). There was an adequate amount of face-to-face interaction (x = 5.33), and adequate frequency of communication (x = 5.67). There was adequate recognition (x = 6.50), successes were acknowledged (x = 5.67) and celebrated (x = 5.33). Upper management gave an adequate amount of support to this collaboration (x = 5.17).

Negatives. The collaboration is not on schedule (x = 2.17), not within its budget (x = 2.60), and the schedule was not realistic (x = 3.00). Staff turnover presented obstacles for this collaboration *(x = 5.00), and there was not adequate administrative support for team members (x = 3.67).

Differences by Job Level of respondent

There were no statistically significant differences in the data when job level was used as a predictor variable. Levels and size of this variable are as follows: Upper Management *(n = 30),* Middle Management *(n = 37),* Line Worker *(n = 25).*

Differences by Enterprise of respondent

The enterprise of the respondent was a significant predictor of the scores on a number of questions. Significance levels and question score averages are below. Enterprise does not serve as a predictor variable for questions having to do with team work, communications, or co-location. Center does serve as a predictor for questions having to do with collaboration targets (success, schedule, budget), planning, funding, and recognition.

Question	**p**	**μ**
I consider this collaboration to be a success, or clearly working towards a successful outcome.	.001	5.59
There was/is an effective mechanism/metric to measure the success of this collaboration.	.05	4.87
The collaboration is being/has been completed on schedule.	.001	4.40
The schedule for this collaboration was realistic.	.01	4.39
The collaboration is being/has been completed within budget.	.05	4.51
The distribution of funding strained working relationships.	*.05*	*3.65*
Control over the collaboration was equitably distributed between Centers/Partners.	.05	4.17
The rate of staff turnover presented obstacles in this collaboration.	*.05*	*3.49*
The members of the collaboration team had the same collaboration goals.	.05	4.49
There was adequate recognition of my work and responsibilities in this from my superior.	.001	5.46
Successes of the team were acknowledged.	.01	5.13
Successes of the team were celebrated.	.05	4.66

Code A *(n =1)*

There was only one respondent from this team who filled out a questionnaire. Therefore it would be misleading to present findings for the collaboration based on a sole individual's perceptions.

Code M *(n =17)*

Code M had mostly neutral scores on these questions, but respondents did note that control was not equitably distributed between Centers/Partner (x = 2.82), and that members of the collaboration team did not have the same goals (x = 3.47).

Code R *(n = 44)*

Code R respondents noted one negative: collaboration(s) not being completed on schedule (x = 3.50). They had very positive responses as to whether collaborations were successful (x = 5.80), and if there was adequate recognition from superiors for work and responsibilities (x = 5.63).

Code S *(n = 6)*

Code S had very positive average scores for each of the questions. Their collaboration(s) were successful (x = 6.17), there were effective metrics to measure success (x = 5.67), collaboration(s) were completed on schedule (x = 5.67), within budget (x = 5.17), the schedule was realistic (x = 5.17), and the distribution of funding did not strain working relationships *(x = 2.83). Control was equitably distributed (x = 5.67), staff turnover did not present obstacles *(x = 2.33), and members of the collaboration(s) had the same collaboration goals (x = 6.00). There was adequate recognition from superiors (x = 6.00), and successes were acknowledged (x = 6.00) and celebrated (x = 5.50).

Code U *(n = 4)*

The one negative noted was that control was not equitably distributed between centers/partners (x = 3.50). The collaboration(s) were successful (x = 6.17), completed within budget (x = 5.00), and there was adequate recognition from superiors (x = 5.25).

Code Y *(n = 12)*

These collaboration(s) were successful (x = 6.67), there were effective metrics to measure success (x = 5.75), collaboration(s) were completed on schedule (x = 6.33), within budget (x = 5.55), the schedule was realistic (x = 6.00), and the distribution of funding did not strain working relationships *(x = 2.58). Members of the collaboration(s) had the same collaboration goals (x =

5.75). There was adequate recognition from superiors (x = 6.25), and successes were acknowledged (x = 6.42) and celebrated (x = 5.67).

Non-NASA Entities (Industry/Academia/Contractors) *(n = 8)*

The respondents from outside of NASA also had positive scores on a good number of these questions. Their collaboration(s) were successful (x = 5.50), there were effective metrics to measure success (x = 5.75), collaboration(s) were completed on schedule (x = 5.00), and within budget (x = 5.88). Staff turnover did not present obstacles *(x = 1.63). There was adequate recognition from superiors (x = 6.14), and successes were acknowledged (x = 5.88) and celebrated (x = 5.38).

Codes S and Y had the most positive results, and Code M the most negative. However, these results need to be looked at with caution as they may represent work on a single collaboration, rather then several collaborations within an enterprise, and the relative numbers of respondents for each enterprise is not large enough to generalize these results with confidence.

Differences by Center of respondent

The center of the respondent was a significant predictor of the scores on a number of questions. Significance levels and question score averages are below. Center does not serve as a predictor variable for questions having to do with communications, or co-location. Center does serve as a predictor for questions having to do with collaboration targets (success, schedule, budget), planning, funding, team work, and recognition.

Question	**p <**	**μ**
I consider this collaboration to be a success, or clearly working towards a successful outcome.	.001	5.29
The collaboration is being/has been completed on schedule.	.001	4.40
The collaboration is being/has been completed within budget.	.01	4.51
Allocation of accountability was built into the collaboration procedure and applied equitably.	.05	4.33
Unclear team member/partner responsibilities negatively affected working relationships.	*.01*	*3.47*
The members of the collaboration team had the same collaboration goals.	.01	4.49
Control over the collaboration was equitably distributed between Centers/Partners.	.001	4.17
Funding for this collaboration was equitably and fairly distributed.	.01	4.78
Funding for this collaboration was adequate to meet collaboration goals.	.01	4.64
The distribution of funding strained working relationships.	*.001*	*3.65*
There was a clear and strong team identity.	.01	5.05
The team members were invested in this collaboration and its outcomes.	.05	5.48
There was a high level of trust between team members.	.01	4.44
There was adequate recognition of my work and responsibilities in this collaboration from my superior.	.001	5.46
Successes of the team were acknowledged.	.001	5.13

Successes of the team were celebrated.	.01	4.66
Upper management gave this collaboration an adequate amount of support.	.01	4.78

Center A *(n = 1)*

There was only one respondent from this team who filled out a questionnaire. Therefore it would be misleading to present findings for the collaboration based on a sole individual's perceptions.

Center B *(n = 7)*

Center B had strong positive scores in all areas but one, which was neutral. Collaborations were successful (x = 6.57), completed on schedule (x = 6.29), and within budget (x = 6.14). Allocation of responsibility was built in to procedure (x = 5.00), and there was a lack of unclear responsibilities that negatively affected working relationships *(x = 2.14). Members of the team had the same goals (x = 5.86) and control was equitably distributed (x = 5.71). Funding was adequate (x = 5.57), distributed equitably (x = 5.71), and its distribution did not strain working relationships *(x = 2.00). There was strong team identity in collaborations (x = 5.86), team members were invested in the collaboration (x = 6.29), and there was a high level of trust between team members (x = 5.57). There was adequate recognition of work and responsibilities from superiors (x = 6.43), successes were acknowledged (x = 6.14), and celebrated (x = 5.29).

Center C *(n = 6)*

Center C also had strong positive scores in most areas. Collaborations were successful (x = 6.33), completed on schedule (x = 5.17), and within budget (x = 5.17). Allocation of responsibility was built in to procedure (x = 5.17), and there was a lack of unclear responsibilities that negatively affected working relationships *(x = 3.00). Members of the team had the same goals (x = 5.67). Funding was distributed equitably (x = 5.50). There was strong team identity in collaborations (x = 6.17), team members were invested in the collaboration (x = 6.33), and there was a high level of trust between team members (x = 6.00). There was adequate recognition of work and responsibilities from superiors (x = 5.67), successes were acknowledged (x = 5.83), and celebrated (x = 5.50).

Center D *(n = 4)*

Center D had no positive scores on these questions, and a number of negative scores. Collaborations were not seen as successful (x = 3.50), and not completed within budget (x =

3.25). Allocation of accountability was not built into collaboration procedure and applied equitably (x = 3.25), unclear partner responsibilities negatively affected working relationships *(x = 5.00), members did not have the same collaboration goals (x = 3.25), and control was not seen as equitably distributed between centers/partners (x = 1.75). Funding was not seen as being equitably distributed (x = 2.00), and its distribution strained working relationship *(x = 5.75). There was not a clear team identity (x = 3.25), and there was a lack of trust between members (x = 2.75).

As with the results for Center E (see below), it needs to be pointed out that all but one of the respondents from Center D had one project in common. Unlike the possible connection between the Center E scores and the collaborative effort associated with that Center, the collaborative effort in this case did not have such uniformly negative results. This makes it slightly more reasonable to assume that Center D's low scores have more to do with Center D than with one particular collaboration, although caution should be used in making this assumption.

Center E *(n = 8)*

Center E, like Center D, had no positive scores on these questions, and a number of negative scores. Collaborations were not seen as successful (x = 3.13), and not completed within budget (x = 3.25). Allocation of accountability was not built into collaboration procedure and applied equitably (x = 2.88), members did not have the same collaboration goals (x = 2.38), and control was not seen as equitably distributed between centers/partners (x = 2.00). Funding was not adequate to meet goals (x = 2.75), was not seen as being equitably distributed (x = 3.25), and its distribution strained working relationship *(x = 5.88). There was not a clear team identity (x = 3.00), and there was a lack of trust between members (x = 3.00). There was not adequate recognition from superiors (x = 3.38), successes were neither acknowledged (x = 2.88) nor celebrated (x = 3.13). Upper management did not give this collaboration an adequate amount of support (x = 2.25).

It should be noted that all Center E respondents had one collaborative effort in common. This collaboration had, by far, the most negative view of its success and very low average scores on many other items. There is no way to tell if these negative scores are a reflection of Center E as a whole, of one unfortunate collaboration, or a combination of both.

Center F *(n = 25)*

Center F had strong positive scores in many areas and no negative scores. Collaborations were successful (x = 6.00), and within budget (x = 5.00). Funding was distributed equitably (x = 5.12). Team members were invested in the collaboration (x = 5.32). There was adequate recognition of work and responsibilities from superiors (x = 6.04), and successes were acknowledged (x = 5.28).

Center G *(n = 6)*

Center G had strong positive scores in many areas, and two negative scores. Collaborations were successful (x = 6.00). Allocation of responsibility was built in to procedure (x = 5.00), and there was a lack of unclear responsibilities that negatively affected working relationships *(x = 2.00). Members of the team had the same goals (x = 5.67) and control was equitably distributed (x = 5.17). Funding distribution did not strain working relationships *(x = 2.17). There was strong team identity in collaborations (x = 5.50), and team members were invested in the collaboration (x = 5.50). There was adequate recognition of work and responsibilities from superiors (x = 6.67), successes were acknowledged (x = 5.50), and celebrated (x = 5.17), and upper management gave the collaboration adequate support (x = 5.83).

The negative scores were for the following areas: projects were not completed on schedule (x = 2.83), or within budget (x = 2.60).

Center H *(n = 13)*

Center H had three strong positive and three strong negative scores. Collaborations were successful (x = 5.15), Funding was adequate (x = 5.62), and there was strong team identity in collaborations (x = 5.08).

The negative scores were for the following areas: projects were not completed on schedule (x = 2.46), or within budget (x = 3.46), and there was not a high level of trust between team members (x = 3.38).

Center I *(n = 1)*

There was only one respondent from this team who filled out a questionnaire. Therefore it would be misleading to present findings for the collaboration based on a sole individual's perceptions.

Center J *(n = 16)*

Center J had strong positive scores in many areas and no negative scores. Collaborations were successful (x = 6.06), and within budget (x = 5.06). Funding was distributed equitably (x =

5.44). There was strong team identity in collaborations (x = 5.44), team members were invested in the collaboration (x = 6.14), and there was a high level of trust between team members (x = 5.00). There was adequate recognition of work and responsibilities from superiors (x = 5.53), successes were acknowledged (x = 6.06), and celebrated (x = 5.13), and upper management gave the collaboration adequate support (x = 5.56).

Non-NASA Entities *(n = 5)*

Respondents who were not from NASA centers had many strong positive scores and one negative score. Collaborations were successful (x = 5.60), and completed on schedule (x = 5.20). Members of the team had the same goals (x = 5.00). There was strong team identity in collaborations (x = 5.80), team members were invested in the collaboration (x = 5.80), and there was a high level of trust between team members (x = 5.00). There was adequate recognition of work and responsibilities from superiors (x = 6.00), successes were acknowledged (x = 6.00), and celebrated (x = 6.20), and upper management gave the collaboration adequate support (x = 5.80).

Those not working at NASA centers did not think that funding was adequate for the project (x = 3.20).

As with the results of differences by enterprise, these results need to be looked at with caution as they may represent work on a single collaboration, rather then several collaborations within a center. Again, the relative numbers of respondents for each enterprise is not large enough to generalize these results with confidence. That being said, Center D and Center E, seen within the results of the collaborations surveyed for this project, have a number of negative scores that impacted the success of collaborations in those centers.

Differences by Total Funding for project

Funding level was a significant predictor for three questions.

Question	**p <**	**μ**
The collaboration is being/has been completed on schedule.	.001	4.40
The schedule for this collaboration was realistic.	.05	4.39
Responsibilities of all team members were clearly defined at the start of the collaboration.	.05	4.24

Less than 100 million *(n = 31)*

On all questions, the average scores for this group were neutral.

100 Million – 500 million *(n = 43)*

Respondents on these projects were less likely to see their projects completed on schedule (x = 3.60), and less likely to have clearly defined responsibilities at the start of their projects (x = 3.79).

More than 500 million *(n = 18)*

Those on the largest projects were more likely to see their projects completed on schedule (x = 5.61) and see the project schedule as being realistic (x = 5.28).

The projects smaller amounts of funding appear to have very neutral results, the mid-range funded projects are more likely to have negative results, and the projects with the most funding are more likely to have positive results on this set of questions.

Differences by Number of People on Collaboration

The number of people working on the collaboration was a significant predictor for 4 items.

Question	**p <**	**μ**
I consider this collaboration to be a success, or clearly working towards a successful outcome.	.05	5.59
Successes of the team were acknowledged.	.05	5.13
The team had access to necessary expertise.	.05	5.66
Unclear team member/partner responsibilities negatively affected working relationships.	*.01*	*3.47*

Less than 100 people *(n = 16)*

In comparison to the other groups, these scores were neutral.

100 – 299 people *(n = 56)*

When there were 100 – 299 people working on a collaboration, they were more likely to see it as successful (x = 5.46), have access to expertise (x = 5.79), and were less likely to think that unclear responsibilities negatively affected working relationships *(x = 3.41)

More than 300 people *(n = 20)*

The largest groups of employees were most likely to see their collaborations as successful (x = 6.35), have their successes acknowledged (x = 5.95), have access to necessary expertise (x = 5.90), and the least likely to think that unclear responsibilities negatively affected working relationships *(x = 2.68)

These results indicate that, for these items, the more people on the project, the better.

Differences by Years for Collaboration (length of project)

The length of time for collaboration was a significant predictor of the majority of questions asked.

Question	p <	μ
I consider this collaboration to be a success, or clearly working towards a successful outcome.	.001	5.59
There was/is an effective mechanism/metric to measure the success of this collaboration.	.01	4.87
The collaboration is being/has been completed on schedule.	.001	4.40
The schedule for this collaboration was realistic.	.001	4.39
Scheduling pressures inhibited the team's ability to work well together.	*.05*	*3.37*
The collaboration is being/has been completed within budget.	.001	4.51
Control over the collaboration was equitably distributed between Centers/Partners.	.05	4.17
Planning for the current collaboration involved input from all relevant parties.	.05	5.00
Allocation of accountability was built into the collaboration procedure and applied equitably.	.01	4.33
The goals for this collaboration were appropriate and realistic.	.05	5.23
The workload was reasonable for this collaboration.	.05	4.88
The rate of staff turnover presented obstacles in this collaboration.	*.01*	*3.49*
The members of the collaboration team had the same collaboration goals.	.01	4.49
This collaboration involved an "us vs. them" attitude.	*.001*	*3.95*
There was a clear and strong team identity.	.05	5.05
There was a high level of trust between team members.	.01	4.44
Team members were willing to share knowledge.	.05	5.38
The team had access to necessary expertise.	.05	5.66
The team members were invested in this collaboration and its outcomes.	.05	5.48
There were conflicts between individuals that inhibited the success/progress of this collaboration.	*.01*	*3.90*
There was adequate recognition of my work and responsibilities in this collaboration from my superior.	.001	5.46
Successes of the team were acknowledged.	.001	5.13
Successes of the team were celebrated.	.05	4.66
There was an adequate amount of face to face interaction.	.001	4.87
The frequency of communication between team members was adequate.	.05	5.16
There was adequate administrative support for team members by including collaboration work in performance plans, incentives, etc.	.01	3.90

Under 5 years *(n =26)*

Projects with under 5 years allotted were a significant predictor of some collaboration targets as well as some teamwork items. These projects were seen as successful (x = 5.65), with appropriate goals (x = 5.46) and reasonable workload (x = 5.04). The team had access to necessary expertise (x = 5.50), there was adequate recognition (x = 5.83), and successes of the team were acknowledged (x = 5.23).

However, scheduling pressures did inhibit the team's ability to work together (x = 3.50).

5 – 9 years *(n = 25)*

Projects of this length received planning input from all parties (x = 5.00). Team members were willing to share knowledge (x = 5.04), had access to necessary expertise (x = 5.64), and were invested in the collaboration (x = 5.08), and saw the frequency of communication as adequate (x = 5.36).

There were negative scores for the collaboration being completed on schedule (x = 2.92), and for the schedule being realistic (x = 3.52). These did not remain within budget (x = 3.46). Members did not have the same collaboration goals (x = 3.60), and there was a lack of trust between members (x = 3.68). Upper management did not adequately support these projects (x = 3.17).

More than 10 years *(n = 31)*

This group had positive scores on almost all questions. The collaboration was successful (x = 6.52), with effective metrics to measure success (x = 5.65), completed on schedule (x = 5.61), within budget (x = 5.47), with a realistic schedule (x = 5.42). Planning involved input from all parties (x = 5.55), the allocation of accountability was built in to procedure (x = 5.07), goals were realistic (x = 5.65), workload was reasonable (x = 5.32), and staff turnover did not present obstacles *(x = 2.60). Team members had the same goals (x = 5.42), a strong team identity (x = 5.74), a high level of trust (x = 5.40), were willing to share knowledge (x = 6.19), had access to necessary expertise (x = 6.10), and were invested in the project (x = 6.19). There was not an "us vs. them" attitude *(x = 2.71), nor did conflicts between individuals inhibit success (x = 2.94). There was adequate recognition (x = 6.13), and successes were acknowledged (x = 5.94), and celebrated (x = 5.35). There was an adequate amount of face-to-face interaction (x = 5.65), and the frequency of communication was adequate (x = 5.77).

No Scheduled End Date *(n = 10)*

Ongoing collaborations had fewer positive and negative scores than those with fixed time tables. Team members were willing to share knowledge (x = 5.20) and were invested in the project (x =5.70). There was an adequate amount of face-to-face interaction (x = 5.00).

The schedule (or perhaps lack thereof) was not realistic (x = 3.20), control was not equitably distributed between centers/partners (x = 3.10), the workload was not reasonable and upper management did not adequately support these projects (x = 3.10).

Collaboration targets (success, budget, scheduling) were best met by projects longer than 10 years and most negatively met by projects 5 – 9 years in length. Planning (goals, workload,

accountability, staff turnover) was most positive in projects over 10 years. Team dynamics were reasonably equal between 5 – 9 year projects and projects longer than 10 years. Acknowledgment was strongest for projects over 10 years. These projects also had the highest average score for success of the collaboration.

Differences by whether there were different Actual and Scheduled End Dates

Whether or not there was a difference between scheduled and actual end dates was a solid predictor variable for the scores on many questions. These differences were a bit counter-intuitive. Projects with *no* difference between scheduled and actual end dates had largely neutral scores on these questions, projects *with* a difference between scheduled and actual end dates were significantly more positive on a number of questions, and ongoing projects were significantly more negative.

Question	**p <**	**μ**
I consider this collaboration to be a success, or clearly working towards a successful outcome.	.05	5.59
There was/is an effective mechanism/metric to measure the success of this collaboration.	.01	4.87
The collaboration is being/has been completed on schedule.	.05	4.40
The schedule for this collaboration was realistic.	.001	4.39
Scheduling pressures inhibited the team's ability to work well together.	*.01*	*3.37*
The collaboration is being/has been completed within budget.	.01	4.51
Planning for the current collaboration involved input from all relevant parties.	.01	5.00
The goals for this collaboration were appropriate and realistic.	.01	5.23
The members of the collaboration team had the same collaboration goals.	.05	4.49
Responsibilities of all team members were clearly defined at the start of the collaboration.	.001	4.24
Unclear team member/partner responsibilities negatively affected working relationships.	*.01*	*3.47*
Allocation of accountability was built into the collaboration procedure and applied equitably.	.05	4.33
The rate of staff turnover presented obstacles in this collaboration.	*.05*	*3.49*
The workload was reasonable for this collaboration.	.001	4.88
There was adequate recognition of my work and responsibilities in this collaboration from my superior.	.05	5.46
Successes of the team were acknowledged.	.001	5.13
Successes of the team were celebrated.	.01	4.66
There was adequate administrative support for team members by including collaboration work in performance plans, incentives, etc.	.001	3.90
Upper management gave this collaboration an adequate amount of support.	.05	4.78

No difference *(n =53)*

This group had a successful collaboration (x = 5.47), and had adequate recognition from superiors (x = 5.35). However, there was not adequate administrative support with the inclusion of collaboration work in performance plans, incentives, etc. (x = 3.48).

Different Scheduled and Actual end dates *(n = 29)*

When there was a difference between scheduled and actual end dates, the collaborations were seen as a success (x = 6.10), with effective metrics to measure success (x =5.57). Oddly enough, respondents indicated that the collaborations were completed on schedule (x = 5.21), with a realistic schedule (x = 5.59), and that scheduling pressures did not inhibit the ability for team members to work together *(x = 2.76). The collaborations were completed within its budget (x = 5.46).

Planning for the collaboration involved input from all parties (x = 5.62), the goals were realistic and appropriate (x = 5.93), responsibilities were clearly defined at the start of the collaboration (x = 5.25), and team members had the same goals (x = 5.28). Staff turnover did not present obstacles *(x =2.63), and workload was reasonable (x = 5.76). There was adequate recognition from superiors (x = 6.00), successes were acknowledged (x = 6.10) and celebrated (x = 6.10), and upper management gave the collaboration adequate support (x = 5.48).

No Scheduled End Date *(n = 10)*

Although these respondents saw upper management as giving adequate support to these collaborations (x = 5.10), there were a number of negatives associated with ongoing collaborations. The schedules are not seen as being realistic (x = 3.20), and responsibilities were not clearly defined at the start of these projects (x = 3.20). The workload is not reasonable (x = 3.50), and there was not adequate support for team members by including collaboration work in performance plans and incentives (x = 3.10).

Differences by Percent of Time respondents spend on Project

There were only two questions for which percent of time the respondent works on the collaboration were significant predictors.

Question	**p <**	**μ**
This collaboration involved an "us vs. them" attitude.	*.05*	*3.95*
The rate of staff turnover presented obstacles in this collaboration.	*.01*	*3.59*

Less than 50% *(n = 21)*

Those working less than 50% of their time on the collaboration perceived less of an "us vs. them" attitude *(x = 2.90) in the collaboration, and did not see staff turnover as presenting obstacles to the success of the collaboration *(x = 2.79).

50 – 99% *(n = 27)*

These respondents did not see staff turnover as presenting obstacles to success *(x = 2.85).

Full Time *(n = 44)*

For both questions, the average scores for this group were neutral.

A possible explanation for these results is that those working less than full time are not as aware of the obstacles presented by high staff turnover, and those working less than 50% are less aware of any "us vs. them" attitudes, while still being aware of obstacles presented by turnover.

Differences by the Length of Time respondents have worked on Project

This was a significant predictor of collaboration targets and planning as well as team dynamics, but did not predict any other of the broader areas of investigation. There is also a fascinating trend in the progression of attitudes as the level of years increases. There are strong positive results in many areas for those working less than 1 year, 1 – 2 years, and 2 –3 years, then there is a dramatic drop. Those working 3 –4 years have no positive averages and many negatives, especially in the area of teamwork. The averages pick up again and are even more positives in the 4 – 8 year category, with the most positive averages in those working longer than 8 years on the collaboration. Looking at the data, those working 3 – 4 years did not have any other demographic data in common, meaning that we are not seeing these scores because they reflect another value measured, such as which collaboration they worked on or what center they work at. There is no clear explanation for the significantly more negative scores given by those working 3 – 4 years. Some possibilities (only theories), are that this could be a history effect, where there is something about the time period 3 –4 years ago when that group was assigned to collaborations, that negatively impacted their attitudes, especially towards teamwork. Or, possibly there is something akin to a 7 year itch that takes place between 3 – 4 years on a collaboration.

Question	**p <**	**μ**
I consider this collaboration to be a success, or clearly working towards a successful outcome.	.05	5.59
The team members chosen were appropriate for the collaboration and its goals.	.05	5.65
The goals for this collaboration were appropriate and realistic.	.05	5.23
Allocation of accountability was built into the collaboration procedure and applied equitably.	.05	4.33
The distribution of funding strained working relationships.	*.01*	*3.65*
Unclear team member/partner responsibilities negatively affected working relationships.	*.05*	*3.47*
There was an adequate amount of face to face interaction.	.05	4.87

The members of the collaboration team had the same collaboration goals.	.05	4.49
There was a clear and strong team identity.	.05	5.05
There was a high level of trust between team members.	.05	4.44
There were conflicts between individuals that inhibited the success/progress.	*.01*	*4.60*
The team members were invested in this collaboration and its outcomes.	.01	5.48
Upper management gave this collaboration an adequate amount of support.	.05	4.78

Less than 1 year *(n = 21)*

These respondents saw the collaboration as successful (x = 5.90), team members chosen were seen as appropriate (x = 5.86), and goals were realistic (x = 5.46). There was a clear and strong team identity (x = 5.14), and team members were invested in the collaboration (x = 5.62). Individual conflicts did not inhibit success *(x = 3.05).

1 – 2 years *(n = 20)*

Collaboration were seen as successful (x = 5.40), and team members chosen were seen as appropriate (x = 5.70). Team members were invested in the collaboration (x = 5.10) and upper management gave collaborations adequate support (x = 5.15).

2 – 3 years *(n = 18)*

These respondents saw the collaboration as successful (x = 5.33), team members chosen were seen as appropriate (x = 5.67), and goals were realistic (x = 5.33). There was an adequate amount of face-to-face interaction (x = 5.06). Team members were invested in the collaboration (x = 5.61), and upper management gave collaborations adequate support (x = 5.44).

3 – 4 years *(n = 9)*

Working on a collaboration for 3 – 4 years is a negative predictor for the average scores of the following. Allocation of accountability was not built into collaboration procedure (x = 2.89), the distribution of funding negatively affected working relationships *(x = 5.11), and upper management did not adequately support the collaboration (x = 3.00). A strong team identity was lacking (x = 3.56), trust was not present between team members (x = 3.56), members did not share collaboration goals (x = 2.78), and individual conflicts inhibited the success of the collaboration.

4 – 8 years *(n = 16)*

These respondents saw the collaboration as successful (x = 5.88), team members chosen were seen as appropriate (x = 5.81), and goals were realistic (x = 5.69). The distribution of funding did not strain working relationship *(x = 3.00), and unclear responsibilities did not

negatively affect working relationships *(x = 2.69). There was an adequate amount of face-to-face interaction (x = 5.50). There was a clear and strong team identity (x = 5.69), and were invested in the collaboration (x = 6.06).

More than 8 years *(n = 8)*

These respondents had the highest average score for perceived success of the collaboration (x = 6.75), team members chosen were seen as appropriate (x = 6.50), and goals were realistic (x = 6.13). Allocation of accountability was built in to the procedure and applied equitably (x = 5.00), the distribution of funding did not strain working relationship *(x = 2.50), and unclear responsibilities did not negatively affect working relationships *(x = 2.50). There was an adequate amount of face-to-face interaction (x = 6.13). There was a clear and strong team identity (x = 6.00), a high level of trust (x = 6.25), members had the same collaboration goals (x = 5.88), were invested in the collaboration (x = 6.63) and individual conflicts did not inhibit success *(x = 2.13).

Executive Survey Results

There were several predominant themes in this survey. The first is that for a collaboration to be successful, there must be buy-in from all parties, and a clear understanding of priorities, roles, and responsibilities. The road to success seems to be paved with very good and intensive ground work before the project actually gets underway. The second theme is that of communication and understanding. A collaboration requires a heavy time investment in building relationships between partners and understanding the culture of each party. Communication and knowledge sharing are also of high importance, but far more difficult unless the time is invested in the personal relationships and cross-cultural understanding between parties. It is also very important for the top levels of management to disseminate information back down the ladder as to the decision-making process, and to have feed-back coming up the ladder, and that the manner in which the feed-back is used is clearly understood.

In essence, there needs to be not only good communication at the top levels of the collaboration, but also throughout the system and down the ladder of responsibility for buy-in from all of the people working on the collaboration. The joint management of collaborations, where there is a governing body representing all parties, seems to have been pivotal in the success of at least one project. This idea clearly relates to other themes mentioned in the previous analyses, in that all parties have a say in governing decisions, and there is a high-level body that can handle communication lapses and disputes in a way that no one side of the collaboration is cut out of the decision-making process.

The weakest point in the overall response is incentives for collaboration. Although it was pointed out that people should be acknowledged during the collaboration, and not just at the end, there were no tangible incentives for collaboration mentioned, other than the actual goals of the collaboration. On the contrary, while it is clear that a successful collaboration is highly desirable for a number of reasons, it is also a reasonably "high-risk" proposition.

The following are the major points made by Executive Survey respondents. A copy of the survey is attached as Appendix C.

What has contributed to success

- People were willing to share knowledge with each other, everyone was part of the discussion and also part of the solution.

- Support at the Center level, wherein each Center brought in their own expertise and the projects were tailored to Center strengths, and bringing the resources together of all parties, also contributed to success.
- Having joint management of different partners, where there was a governing body at the top consisting of and representing all parties.
- High end supercomputers.

What has contributed to failure
- It can be difficult to get more than 2 or 3 Centers to partner with an idea.
- Centers who do not need outside help and are self-contained may not need to share information.

What role did Executives see themselves in regarding collaborations?
- Identify needs for the project and provide: resources, talent, agency events to pull people together.
- Promote positive thinking of each other's strengths.
- Set clear goals, objectives and strategies, then get out of the way.
- Listen to field centers.
- Maintain what is built.
- Know needs and goals of NASA and keep project focused on those.
- Don't take sides.
- Make Center Directors part of the decision making process.
- Understand other cultures, and spend time within those cultures.
- Build relationships, which you must have for successful collaboration.
- Have management structure in place, support and advise them, with the understanding that it takes an investment of time.

Results of the collaborations
- An initial workshop, where there were shared stories and knowledge, created a strong community of well-respected, competent project managers and engineers that shared knowledge with others.
- Collaboration was a phenomenal success, more willing to take risks, more synergy to obtain.
- After meeting with the right people, worked together instead of separately, leaving pride at the door.

Why would you like to work on more collaborative efforts?
- Must have collaboration to get good product – using different talents.
- It's important to the Enterprise, it's fun, efficient, and makes everyone better – it's the right thing to do.
- Must collaborate internationally to do our job.
- As resources shrink, can't afford to duplicate skills.
- We get more done when we work together.

Why would you *not* like to work on more collaborative efforts?
- If you don't have the right people, attitudes, in place, will be a waste of resources and there won't be success.
- There are many good managers who are also control freaks - won't be a success.

What incentives are there for you to be involved in further collaboration?
- When a project is done right, it's a thing of beauty, a complex artwork.
- Love learning about other people, cultures and philosophies.
- Get to work with phenomenal people.
- Widest possible distribution of data, information and knowledge.
- Clearly you can do things you can't do otherwise.

What disincentives are there for you to be involved in further collaboration?
- High risk – reputations rests on success.
- People above are driving.
- Hard to partner with other organizations in other locations.

What can be done to improve the collaborative process at NASA?
- Be comfortable with people leading projects – believe the people you selected are talented and mean to do the right thing.
- Give them freedom to perform and autonomy to meet goals.
- Know goals/outcomes, stay close to organization.
- People should not be punished for either failures or successes.
- Make it easier for people to collaborate and do their job.
- Select people who are successful and collaborative, not control freaks and those who just maintain.
- Meaningful assignments, growth opportunity, autonomy, scorecard (benchmarking).
- Emphasize what works, eliminate what doesn't and eliminate barriers.
- Be clear about roles and responsibilities.
- Develop sense of inter-dependency.
- Reward people during process, not just at the end.
- Protection of people who propose grand ideas.
- Process to build bridges, have retreats, and structure a program so collaboration is a requirement.

What incentives for collaboration are currently in place at NASA?
(It should be noted that there were no clear, direct answers to this question, there was a re-stating of what does or does not work in collaborations.)
- Desire to be successful.
- People are naturally collaborators.
- None, it's all a risk, reward is if you are successful.
- Collaboration produces the widest possible application of products at any level.

Summary of Results

One of the most interesting results of the statistical analyses was that every question asked on the questionnaire was significantly correlated to whether or not respondents perceived the collaboration as successful. This indicates that all of the elements present in the questionnaire are relevant to the success of collaborative efforts. The results from both surveys serve to explain the reasons for the importance of these elements in more detail and define not only areas that can use improvement, but the ways in which these areas can be improved.

NASA has a unique capability to bring together a tremendous amount of talent and knowledge, combined with an enthusiastic and dedicated workforce who are motivated to get the job done and to do it well. There are, however, consistent barriers to achieving the full potential of the agency. Inter-center rivalry and competition and the resulting lack of communication present consistent problems.

The LDP group has identified elements that are integral to the success of collaboration at NASA. Simply put, the more of these elements that are in place, and the stronger those elements are, the more successful the projects appear to be.

The road to successful collaboration seems to hinge largely on three areas of investment. The first is an up-front investment in establishing common and agreed upon goals, processes, roles and responsibilities and establishing buy-in from all parties, *before* the project begins. The second investment is in the human element. The importance of interpersonal communication can not be overstated. The investment in travel to facilitate face-to-face communication is an investment in the success of the project. Establishing personal relationships is pivotal in overcoming barriers presented by differences in culture, difference in processes, center rivalries and in establishing trust and the willingness to share knowledge. Along these lines, an accessible, reliable videoconferencing system, if possible with document sharing capability, can go a long way to bridge the distance when travel is not possible for financial reasons or due to timing. The third area of investment is that of management investment in the project. Regularly scheduled project oversight, involving management from *all* parties, is very important, but should not be read to mean micromanagement. The input and guidance of management is seen as pivotal, as is having a forum to resolve any issues or conflicts. Communication between the management of various parties in the collaboration is pivotal. And lastly, recognition, from the

very informal and personal, to more structured recognition with clear standards involving awards, is important.

The following is a quick summary of both survey and questionnaire results included for easy reference.

Quick summary of survey results

- NASA as a whole has a number of strengths that lend themselves to collaborative efforts. NASA has a workforce filled with pretty remarkable people, who are motivated, strive for excellence, have a wealth of knowledge, and a willingness to do what it takes to "get the job done and get it done right." All of these attributes are directed towards the goals of good science and the furtherance of knowledge.
- When team dynamics are positive, the payoff is tremendous. NASA has a unique ability to assemble a huge amount of talent, which makes it possible to have all the expertise required for success. Bringing people together from different centers and/or working cultures affords the opportunity for a dynamic cooperative process in which new ideas, new perspectives, and new ways of doing things can surface and be discussed, resulting in a better final product, and an enhanced scientific capability. This can result in a substantial increase in the knowledge base. The positive effects of team dynamics was especially apparent when there was adequate face-to-face interaction between team members. This interaction also led to a better understanding and appreciation of NASA as a whole, of different centers and groups, and of different points of view. Strengthened personal relationships were also seen as an important asset. Networking with peers and forming good relationships was seen as key in enhancing the collaborative process.
- When asked about the types of technology used and what technology would enhance collaboration, non-technology oriented answers were the most commonly given, such as face-to-face meetings, facilitators, and travel to other centers These responses reinforce the importance of personal interaction in collaborations. There is simply no substitute for personal interaction in the ability to form relationships, establish trust, work through issues, and collaborate.
- The formality or informality of agreements did not seem to be of particular importance. What was important was whether or not the agreement had buy-in from all parties, clearly defined roles and responsibilities at the beginning of the project, that agreements were put in

place soon enough in the project to be effective, and that they could be flexible enough to deal with changes in the project as it progresses. These responses indicate a strong need for substantial up-front planning before the beginning of a collaboration.

- Inter-center/enterprise competition manifests itself in turf protection, lack of communication, lack of trust, and lack of respect for other groups and centers. It has also resulted in an inflexible mindset for many. As a consequence, many people are unwilling to be open to new ideas or different ways of doing things. This can create friction and damage the potential for collaboration, because there is no point of negotiation and therefore no way to move forward. The obstacles that result from inter-center conflict were seen in the answers to a number of questions. These obstacles create an atmosphere fundamentally opposed to all the precepts of collaboration. The ability to have interpersonal interaction, whether through face-to-face meetings, team-building retreats, detail assignments, or co-location, is seen as substantially improving the ability to overcome these obstacles.
- Cultural differences between centers, when not presented as center rivalry, most often showed up as differences in processes between centers. These differences led to frustration and confusion and can also lead to mistrust and an unwillingness to communicate. There is a need for up-front planning to blend processes, not simply have one group's processes dominate, so that there is agreement and buy-in at the beginning. Different levels of formality, in both processes and more ephemeral things such as attitudes, also led to confusion and frustration. These problems can be overcome by increased personal interaction, so that people can learn how other centers operate and learn to understand each other's cultures.
- Budget processes, and sometimes the lack of an adequate budget, were also recurring themes in many questions. There appeared to be a very strong desire for consistency, clarity, and simplification in the budget and procurement processes. The lack of travel funds, or of control over travel funds, was also presented as an obstacle in the answers to several questions.
- Recognition was not consistent, and not always timely. While many felt that their work and accomplishments were recognized, an equal number did not. There does not appear to be a consistency in either the standards for, or application of, recognition. An agency-wide approach to recognition that is clear, consistent, and timely, in which the standards for recognition are known to all, would be well considered. Peer recognition is seen by many as the most meaningful form of recognition, which should be strongly taken into consideration.

- There does not seem to be a wide-spread use of metrics to measure the progress or success of collaborative efforts. The most common measures of success are whether a project is completed on schedule, completed within budget, or the mission/project's success. Having success as a metric for success is a bit like saying builders were successful in building a house because the house exists. This may not take into account the elements of the house (e.g. is the wiring any good, is the plumbing good, etc.)
- Fear of failure and risk aversion were also mentioned as inhibitors to success. In the words of respondents, "it is not ok to fail, so it is not ok to be honest" and "no one could make a decision because no risk was acceptable." Solutions mentioned were establishing a level of acceptable risk, and less "liability" for failure.
- Support from senior management is most often evident in the provision of sufficient funding and the lack of micromanagement. When provided, regularly scheduled reviews or oversight of some kind, is perceived as very helpful, so that guidance can be provided and issues or conflicts can be resolved. When reviews are not provided, it was often mentioned as something that would further contribute to success.
- There is a lack of consistency in the management of personalities. Sometimes they are, sometimes they aren't. Difficult personalities, especially when ego-related, can be highly disruptive to collaboration. As one respondent stated, "the arrogance of a number of very bright people can be very disruptive."
- Whether or not roles and responsibilities are clearly defined has a strong impact on the success of a collaboration. The definition needs to be established at the beginning of a project. A lack of clarity in roles and responsibilities most often results in wasted resources, time and energy, frustration, and lowered morale.
- Within NASA collaborations, contractors are often treated with a lack of respect, as "second class citizens." This is very demoralizing and leads to high levels of frustration. This makes collaboration more difficult and far less pleasant.
- Teamwork in not consistently included in performance plans. Approximately 1/3 of respondents stated that it was an element, or part of an element in their performance plan, another 1/3 said it was implied, and 1/3 said that it was not included at all.

<u>Quick summary of questionnaire results</u>

The analyses of variance produced many interesting findings. It is clear that the degree of success for a collaborative effort is related to the number and strength of the elements in the questionnaire that are present. The more elements present and the more positive they were, the more successful the collaboration was. It is also interesting to look at how collaborations with positive and negative aspects balanced these out to create a level of success in their collaboration.

- The job level of respondents had no relation to any of the questions asked, which can be viewed as very positive. It points towards uniformity in the understanding of collaborative efforts. A disconnect between working levels in understanding can be a crippling barrier. Fortunately, this does not seem to be an obstacle for NASA.
- There are significant differences between how both enterprises and centers view items having to do with collaboration targets, such as success, schedule, and budget, as well as planning, funding and recognition. However, though the general areas of difference for both enterprises and centers are the same, center was a significant predictor of more questions within these areas. Codes S and Y had the most positive results, and Code M had the most negative results. The most dramatic result for the analysis of the centers were the scores for Center E and Center D. For both of these centers, the results were overwhelmingly negative. While these are potentially very important results, it should be noted that the respondents from Center E were also working on a very negatively rated project, and those from Center D were respondents on two projects, one of which had scores in a very neutral area. How much the combined elements of project and center co-mingle needs further exploration.
- The level of funding for a collaborative effort showed differences only in scheduling issues and whether or not responsibilities were clearly defined at the beginning of the collaboration. Respondents working on the largest projects (over 500M) demonstrated the best results in these areas.
- When there were more than 300 people assigned to a collaboration, there were higher scores on the success of the collaboration, acknowledgement of success, access to expertise, and clearly defined responsibilities.
- The number of years for collaboration was a significant predictor of the scores on many questions in the areas of collaboration targets (success, budget, scheduling), planning (goals,

workload, accountability, staff turnover) and team dynamics. Projects 5 – 9 years in length had the most negative scores and those over 10 years had the most positive scores.

- There was a similar dip in scores for those working on a collaboration for 3 – 4 years. These respondents had negative scores on questions relating to team dynamics as well as allocation of accountability and distribution of funding. For those working fewer years there were moderately positive scores in these areas, and for those working more years there were very positive scores.
- Interestingly enough, those respondents who worked on projects where there was a difference between the scheduled and actual end dates were significantly more likely to respond that the collaboration was on schedule and that success was not inhibited by scheduling pressures.
- Respondents working less than full time on a collaboration perceived less of an "us vs. them" attitude and did not see staff turnover as being an obstacle to success.

Appendix A - Collaboration Survey

Questionnaire returned: yes / no

Date: _____ Total funding for collaboration: _____

Name: _____ # of people working on collaboration: ____

Name of collaboration: _____ Start Date of collaboration: _____

Collaboration role/title: _____ Scheduled/Actual End date: _____/_____

Center: _____ Time you personally have spent in collaboration to this point: _____

Brief description of collaboration:_____

_____

1. What technology was used as a tool for communication in this collaboration? (examples: phone, email, virtual teaming, etc.)

2. What kinds of technology would have offered a significant improvement on your ability to communicate and affect the success of the collaboration?

   How would this technology have made the collaboration more likely to succeed?

3. What types of *formal agreements* are recognized and recorded as to who is responsible for various aspects of the collaboration?

   Was this type of agreement effective?

   Would a less formal agreement have been helpful?

4. What types of *informal agreements* are recognized and recorded as to who is responsible for various aspects of the collaboration?

   Was this type of agreement effective?

   Would a more formal agreement have been helpful?

5. What organizational processes inhibited collaboration?

How did these inhibit collaboration?

How would you fix these things?

6. What organizational processes enhanced collaboration?

How did these enhance collaboration?

5. What are the cultural traits of NASA and/or the working groups that inhibited collaboration?

How did these inhibit collaboration?

How would you fix these things?

6. What are the cultural traits of NASA and/or the working groups that enhanced collaboration?

How did these enhance collaboration?

7. In what ways did the parties involved in this collaboration receive recognition for their work?

How could recognition of people and teams be improved?

8. What metrics were used to measure the success or failure of this collaboration?

9. How did Senior Management support this collaboration?

What other kinds of support would have been helpful?

10. What were some of the problems resulting from team dynamics, or the working relationships between different teams in the collaboration?

11. What were some of the assets resulting from team dynamics, or the working relationships between different teams in the collaboration?

12. Were the characteristics and personalities of team leaders and team members taken into consideration and managed at an appropriate level? Please explain.

13. What were some of the problems created by a difference in *organizational culture* between team members? Please explain.

14. What are the top 2 or 3 elements that have contributed to the collaboration's success?
15. What are the top 2 or 3 elements that have inhibited the success of this collaboration?
16. How was teamwork included in your performance plan?
17. Do you have any thoughts on any mechanisms or cultural issues that are important to make a collaborative effort successful?

18. Is there anything else that you would like to share with us?

Appendix B – Collaboration Questionnaire

Date: _____ Total funding for collaboration: _____

Name: _____ # of people working on collaboration: ____

Name of collaboration: _____ Start Date of collaboration: _____

Collaboration role/title: _____ Scheduled/Actual End date: _____/_____

Center: _____ Time you personally have spent in collaboration to this point: _____

Please mark the most appropriate response to the following questions in the space provided.

1 = strongly disagree 4 = neither agree nor disagree 7 = strongly agree

Question	1	2	3	4	5	6	7
I consider this collaboration to be a success, or clearly working towards a successful outcome.							
The team members chosen for this collaboration were appropriate for the collaboration and its goals.							
There was/is an effective mechanism/metric to measure the success of this collaboration.							
The collaboration is being/has been completed on schedule.							
Team members were willing to share knowledge.							
There was an adequate amount of face to face interaction.							
The members of the collaboration team had the same collaboration goals.							
Communication was difficult because team members were in different locations, which inhibited collaboration success.							
There was a clear and strong team identity.							
Funding for this collaboration was equitably and fairly distributed.							
Control over the collaboration was equitably distributed between Centers/Partners.							
There was adequate recognition of my work and responsibilities in this collaboration from my superior.							
This collaboration involved an “us vs. them” attitude.							
The rate of staff turnover presented obstacles in this collaboration.							
Successes of the team were acknowledged.							

Appendix B – Collaboration Questionnaire

Please mark the most appropriate response to the following questions in the space provided.

1 = strongly disagree 4 = neither agree nor disagree 7 = strongly agree

Successes of the team were celebrated.							
There was a high level of trust between team members.							
The frequency of communication between team members was adequate.							
The physical location of various team members were an obstacle in this collaboration.							
The schedule for this collaboration was realistic.							
Inadequacy of funding strained working relationships.							
Scheduling pressures inhibited the team's ability to work well together.							
The team had access to necessary expertise.							
Unclear team member/partner responsibilities negatively affected working relationships.							
Upper management gave this collaboration an adequate amount of support.							
Planning for the current collaboration involved input from all relevant parties.							
The goals for this collaboration were appropriate and realistic.							
The distribution of funding strained working relationships.							
The workload was reasonable for this collaboration.							
Responsibilities of all team members were clearly defined at the start of the collaboration.							
Allocation of accountability was built into the collaboration procedure and applied equitably.							
There was adequate administrative support for team members by including collaboration work in performance plans, incentives, etc.							
The collaboration is being/has been completed within budget.							
There were conflicts between individuals that inhibited the success/progress of this collaboration.							
Funding for this collaboration was adequate to meet collaboration goals.							
The team members were invested in this collaboration and its outcomes.							

Appendix C – Executive Survey

Date: _____ Center: _____

Name: _____ Enterprise: _____

Title: _____

1. Could you give us some examples of collaborative efforts that have succeeded or failed and why it was success or failure?
   (*for each example given, note whether it was a success or failure*)

2. What was your role in these collaborations?

3. What were the results of these collaborations?

4. Why or why not would you like to be involved in more collaborative efforts?

5. What incentives or disincentives are there for you to be involved in further collaborations?

6. What can be done to improve the collaborative process at NASA?

7. What incentives for collaboration are currently in place?

Appendix D – Means Table

Collaboration average scores listed by Question	Collab. 1	Collab. 2	Collab. 3	Collab. 4	Collab. 5	Collab. 6	Collab. 7	Collab. 8	Collab. 9	Collab. 10	Collab. 11	Collab. 12	Collab. 13	Collab. 14	Collab. 15	Collab. 16
N	**3**	**7**	**6**	**2**	**6**	**7**	**9**	**5**	**5**	**12**	**5**	**6**	**3**	**6**	**1**	**6**
1) I consider this collaboration to be a success, or clearly working towards a successful outcome. ***** μ = 5.59**	6.33	5.43	2.00	6.00	4.67	6.50	4.44	6.40	4.00	6.75	5.40	6.57	5.50	6.33	7.00	6.67
2) The team members chosen for this collaboration were appropriate for the collaboration and its goals. ***** μ = 5.65**	5.33	5.86	3.50	6.00	5.67	6.50	5.78	5.80	2.40	6.33	5.80	6.71	4.75	5.83	7.00	6.33
3) There was/is an effective mechanism/metric to measure the success of this collaboration. ***** μ = 4.87**	4.00	5.14	3.33	5.50	4.83	6.00	3.65	4.40	2.20	5.75	4.00	5.86	5.67	5.83	6.00	5.67
4) The collaboration is being/has been completed on schedule. ***** μ = 4.40**	5.00	2.14	4.17	2.00	3.33	5.75	4.56	5.60	3.20	6.33	2.40	6.57	2.25	5.50	6.00	2.17
5) Team members were willing to share knowledge. **μ = 5.38**	6.00	5.57	4.00	5.00	4.33	6.38	5.00	5.80	2.00	6.25	5.20	6.57	3.50	6.33	7.00	6.17
6) There was an adequate amount of face to face interaction. ***** μ = 4.87**	4.00	5.86	4.83	5.50	3.67	5.88	4.78	3.40	2.00	5.75	3.80	5.57	3.50	6.00	7.00	5.33
7) The members of the collaboration team had the same collaboration goals. ***** μ = 4.49**	4.33	3.57	1.67	4.50	3.33	4.63	3.89	4.40	1.60	6.00	4.60	5.86	5.00	6.17	6.00	5.83
8) Communication was difficult because team members were in different locations, which inhibited collaboration success. *** μ = 4.00**	*4.33*	*2.71*	*4.67*	*3.00*	*4.83*	*3.00*	*4.00*	*4.60*	*4.00*	*3.50*	*6.00*	*3.57*	*6.25*	*3.33*	*1.00*	*4.50*
9) There was a clear and strong team identity. ***** μ = 5.05**	5.00	6.29	2.67	4.50	4.67	5.75	4.67	4.20	2.40	5.92	4.80	6.00	4.00	6.17	6.00	6.00
10) Funding for this collaboration was equitably and fairly distributed. **** μ = 4.78**	4.00	5.29	2.83	5.50	4.17	5.63	3.89	4.60	3.60	4.92	4.25	6.57	3.75	5.67	6.00	5.83
11) Control over the collaboration was equitably distributed between Centers/Partners. **** μ = 4.17**	3.00	3.57	1.83	5.50	3.33	5.25	3.11	4.00	2.80	5.00	5.00	4.57	4.50	5.00	3.00	6.00
12) There was adequate recognition of my work and responsibilities in this collaboration from my superior. ***** μ = 5.45**	5.00	3.71	3.00	6.50	5.50	6.43	4.44	6.40	5.00	6.42	6.20	5.67	6.00	5.67	6.00	6.50
13) This collaboration involved an "us vs. them" attitude. ***** μ = 3.95**	*2.67*	*5.43*	*6.17*	*5.00*	*4.50*	*2.63*	*4.67*	*4.20*	*5.00*	*2.75*	*6.00*	*2.86*	*4.00*	*2.00*	*1.00*	*3.67*
14) The rate of staff turnover presented obstacles in this collaboration. ***** μ = 3.49**	*2.33*	*4.57*	*5.00*	*5.50*	*3.00*	*2.00*	*3.78*	*2.20*	*6.00*	*2.91*	*5.80*	*1.86*	*2.67*	*2.00*	*1.00*	*5.00*
15) Successes of the team were acknowledged. ***** μ = 5.13**	4.33	2.86	2.67	6.00	6.00	5.75	4.44	4.80	4.20	6.50	5.60	6.29	4.75	5.83	6.00	5.67
16) Successes of the team were celebrated. ***** μ = 4.66**	4.33	3.00	3.00	6.00	6.50	5.00	4.11	3.00	3.20	5.75	4.80	5.29	4.00	5.33	6.00	5.33

Appendix D – Means Table

17) There was a high level of trust between team members. ***** μ = 4.44**	4.67	3.43	2.33	6.00	3.17	5.00	4.33	4.00	2.60	5.55	3.20	5.71	4.00	5.83	6.00	5.83
18) The frequency of communication between team members was adequate. **** μ = 5.16**	4.00	5.29	4.83	5.50	5.67	6.00	4.44	4.80	3.20	6.00	4.20	6.14	3.00	6.00	6.00	5.67
19) The physical location of various team members were an obstacle in this collaboration. ***** μ = 3.77**	*4.67*	*2.43*	*3.67*	*4.00*	*5.67*	*2.13*	*4.22*	*4.80*	*4.00*	*3.45*	*5.60*	*2.71*	*4.75*	*3.00*	*1.00*	*4.33*
20) The schedule for this collaboration was realistic. ***** μ = 4.39**	4.33	3.00	3.83	3.00	4.33	5.50	3.22	4.40	3.60	6.00	2.40	5.86	5.75	5.50	3.00	3.00
21) Inadequacy of funding strained working relationships. *** μ = 3.83**	*5.00*	*3.29*	*4.83*	*2.50*	*5.33*	*3.00*	*4.89*	*4.60*	*3.60*	*3.75*	*4.40*	*1.71*	*4.25*	*3.67*	*5.00*	*2.67*
22) Scheduling pressures inhibited the team's ability to work well together. **** μ = 3.37**	*3.33*	*3.57*	*4.33*	*3.50*	*3.50*	*2.13*	*4.78*	*4.20*	*3.20*	*2.75*	*5.60*	*1.71*	*3.50*	*2.67*	*4.00*	*2.83*
23) The team had access to necessary expertise. **μ = 5.66**	5.67	6.00	5.00	6.00	5.67	6.50	4.67	6.00	4.80	6.08	5.60	6.00	4.75	5.83	6.00	5.83
24) Unclear team member/partner responsibilities negatively affected working relationships. ***** μ = 3.47**	*3.67*	*2.71*	*5.17*	*5.00*	*4.33*	*3.25*	*4.44*	*4.00*	*5.00*	*2.00*	*3.60*	*1.71*	*4.75*	*3.00*	*5.00*	*2.67*
25) Upper management gave this collaboration an adequate amount of support. ***** μ = 4.78**	4.33	4.57	1.83	4.00	5.67	6.00	5.00	3.80	2.80	5.58	5.40	5.71	4.50	4.50	6.00	5.17
26) Planning for the current collaboration involved input from all relevant parties. **** μ = 5.00**	5.00	5.00	4.67	4.50	4.50	5.88	3.67	4.20	4.20	5.58	2.60	6.29	6.25	5.67	6.00	5.83
27) The goals for this collaboration were appropriate and realistic. ***** μ = 5.23**	5.33	4.71	3.67	4.50	4.50	5.00	4.56	5.80	4.00	6.25	4.60	6.43	6.25	5.83	5.00	6.00
28) The distribution of funding strained working relationships. ***** μ = 3.65**	*5.00*	*2.86*	*6.33*	*4.00*	*5.50*	*3.00*	*4.00*	*4.00*	*5.00*	*2.75*	*3.80*	*2.14*	*3.75*	*3.17*	*4.00*	*2.00*
29) The workload was reasonable for this collaboration. **** μ = 4.88**	5.00	4.14	4.33	5.50	5.00	5.00	3.56	5.00	4.40	5.75	3.20	6.14	6.25	5.00	3.00	5.50
30) Responsibilities of all team members were clearly defined at the start of the collaboration. ***** μ = 4.24**	3.00	4.57	4.17	5.00	3.83	5.00	3.22	4.60	2.60	5.36	2.20	6.29	5.25	3.50	3.00	3.83
31) Allocation of accountability was built into the collaboration procedure and applied equitably. ***** μ = 4.33**	4.00	4.00	2.33	4.00	3.33	5.13	3.56	3.80	2.80	5.18	3.60	5.86	5.00	5.67	4.00	5.33
32) There was adequate administrative support for team members by including collaboration work in performance plans, incentives, etc. **** μ = 3.90**	3.00	2.00	2.83	5.00	4.17	4.71	3.00	3.80	2.75	4.91	3.60	5.29	5.50	3.83	4.00	3.67
33) The collaboration is being/has been completed within budget. ***** μ = 4.51**	5.67	3.57	2.50	2.50	5.00	6.13	3.89	5.60	4.40	5.64	1.40	6.86	3.25	5.17	6.00	2.60
34) There were conflicts between individuals that inhibited the success/progress of this collaboration. ***** μ = 3.90**	*3.67*	*3.14*	*5.00*	*5.00*	*6.00*	*2.63*	*4.56*	*5.00*	*5.80*	*2.75*	*5.40*	*2.14*	*3.00*	*2.67*	*4.00*	*4.50*
35) Funding for this collaboration was adequate to meet																

collaboration goals. ***** μ = 4.64**	3.33	5.57	2.33	5.50	3.33	5.13	4.44	4.20	4.40	5.00	2.80	6.57	5.75	4.83	6.00	5.17
36) The team members were invested in this collaboration and its outcomes. ***** μ = 5.48**	5.33	5.57	3.17	5.50	4.83	6.00	5.67	5.60	2.00	6.50	5.20	6.57	4.50	6.50	6.00	6.67

~ Italicized questions indicate that higher scores actually reflect a more negative

Significance levels * $p < .05$ ** $p < .01$ *** $p < .001$